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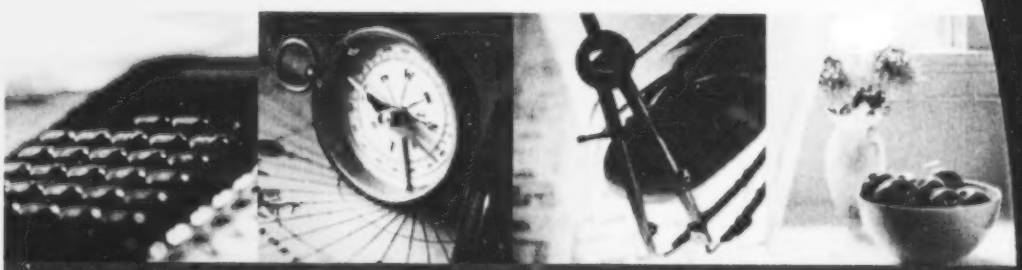

GETTING STARTED!

Guide to Building Regulations in the United Kingdom

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GETTING STARTED!

Guide to Building Regulations in the United Kingdom

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This research project was funded by Canada Mortgage and Housing Corporation (CMHC). The contents, views and editorial quality of this report are the responsibility of the author(s) and CMHC accepts no responsibility for them or any consequences arising from the reader's use of the information, materials and techniques described herein.

Cette publication est aussi disponible en français sous le titre : Pour Commencer! Guide aux réglementations du bâtiment au Royaume-Uni.

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INTRODUCTION

The United Kingdom (UK) is currently the third largest market for Canadian housing exports (after the United States and Japan). Government initiatives toward greater energy efficiency, a growing shortage of skilled trades for masonry construction and a strong UK economy presents opportunities for Canadian housing exporters. Canadian industry and government agencies are interested and are supporting efforts in the UK market. A program of high-quality, energy-efficient Canadian houses, based on Canada's R-2000 Program and the Super E℠ model, has been successfully launched. The first UK Super E℠ (see www.super-e.com for further information) house was officially opened in Kent in South-East England in April, 2002.

Any company that plans to export their housing products and systems or work in the UK market needs to have a basic understanding of UK building regulations and approvals procedures. Many of these regulations and procedures are similar to those in Canada, but there are also important differences.

GETTING STARTED! will help you, as a Canadian exporter of housing systems and components to:

- better understand the UK regulatory framework and what is needed to obtain approvals;
- identify potential trade obstacles; and
- identify regulatory issues, which may require further investigation.

GETTING STARTED! focuses on the market that will be of most interest to Canadian exporters; new-build, low-rise residential buildings up to three storeys above ground; principally detached, semi-detached and row (terraced) housing. This guide covers **wood frame house construction**, known as **timber frame housing** in the UK. It also considers all the related components such as finishes (linings), claddings, insulation, vapour control layers and joinery.

UK terms are used throughout the document to help you become familiar with common UK building language.

GETTING STARTED! is organized into a number of sections:

- **Section 1** describes The Building Regulations 2000 for England and Wales that apply to housing up to three storeys. This section also describes the Canadian export potential.

- **Section 2** gives some essential information which needs to be considered even before an exporter can begin *GETTING STARTED!*.

- **Section 3** describes the way that UK timber frame houses are built to meet these standards, gives an overview of the similarities and differences of Canadian housing design and where necessary, identifies additional measures needed to meet the requirements.

- **Section 4** provides guidance on the UK procedures for approvals and certification for housing products and systems.

- **Section 5** gives an overview of the UK housing warranty schemes.

- **Section 6** provides references and information sources for exporters.

The appendices provide additional information:

- Appendix 1: A Summary of the Approved Documents to the Building Regulations 2000. This summarizes the basic performance requirements and the standards to meet the Building Regulations 2000 for England and Wales.

- Appendix 2: An Overview of Building Regulations for Scotland and Northern Ireland is important for exporters who want to work in Scotland or Northern Ireland, which have separate building regulations.

- Appendix 3: The Housing Corporation "Scheme Development Standards" for Social Housing is relevant to exporters interested in providing social housing.

- Appendix 4: Glossary of Building Construction Terms

This guide will be revised periodically as Canadians learn more about the UK market. Feedback from you, the exporters, will make the revisions more effective and constructive.

Please direct your comments and any questions to:

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SECTION 1: THE BUILDING REGULATIONS 2000 FOR ENGLAND AND WALES

The Building Regulations 2000 for England and Wales are a set of *minimum* standards for health and safety except for two parts. These are Part L for energy conservation that describes minimum standards to reduce CO_2 emissions and reduce the impact of greenhouse gases; and Part M, the disabled access section, that describes minimum standards for design to meet acceptable social standards. The Building Regulations are arranged by function such as structural stability, fire safety or sound insulation, and not by elements such as walls, floors or doors. The actual legal requirement is a simple functional performance statement. Guidance on how to meet this requirement is given in a set of associated Approved Documents (AD's). The AD's are not mandatory but, by using the guidance in these, a designer "tends to show compliance" with the Building Regulations. Any other method of meeting the requirements may be specified, but the designer may have to demonstrate that this method does comply.

In the preparation of *GETTING STARTED!*, The Building Regulations 2000 were compared to Part 9 of the National Building Code of Canada 1995, which is a combination of functional and elemental requirements. (For example there are two elemental sections; one on "doors" [9.6], and one on "windows" [9.7], which is then followed by the functional performance requirements for "means of egress" [9.8].) *GETTING STARTED!* does not directly compare the function and element requirements of the two sets of regulations. Instead, differences in approach and construction practice are highlighted and references to further information are included.

The basic functional performance requirements of each of the Parts of The Building Regulations 2000 relevant to housing up to three storeys, are given in *Appendix 1: A Summary*. A short description of each of the standards that are considered to meet these performance requirements is also given.

The Approved Documents to The Building Regulations 2000 covered in *GETTING STARTED!* are:

- **Approved Document A** - Structure (1992 Edition)
- **Approved Document B** - Fire safety (2000 Edition)
- **Approved Document C** - Site preparation and resistance to moisture (1992 Edition)
- **Approved Document E** - Resistance to the passage of sound (1992 Edition)
- **Approved Document F** - Ventilation (1995 Edition)
- **Approved Document K** - Protection from falling, collision and impact (1998 Edition)
- **Approved Document L1** - Conservation of fuel and power in dwellings (2002 Edition)

- **Approved Document M** - Access and facilities for disabled people (1999 Edition)
- **Approved Document N** - Glazing - safety in relation to impact, opening and cleaning (1998 Edition)
- **Approved Document for Regulation 7** - Materials and workmanship (1999 Edition)
- **Amendments 2000** to the Approved Documents

There are other Approved Documents which are not considered relevant for exporters involved in housing up to three storeys. These are:

- **Approved Document D** - Toxic substances (1992 Edition)
- **Approved Document G** - Hygiene (1992 Edition)
- **Approved Document H** - Drainage and waste disposal (2002 Edition)
- **Approved Document J** - Combustion appliances and fuel storage systems (2002 Edition)
- **Approved Document L2** - Conservation of fuel and power in buildings other than dwellings (2002 Edition)

The AD's are continually updated and changes posted to the Web site (www.safety.odpm.gov.uk/bregs).

To obtain copies of The Building Regulations 2000 and all of these AD's see *Section 6: References and Further Information.*

SECTION 2: SOME NOTES BEFORE GETTING STARTED!

THE ROLE OF DESIGN PROFESSIONALS IN THE UK

An exporter or any one else wishing to build housing, can employ a UK registered architect to provide a full service including design, contract preparation, running the building contract, supervising the project and providing a completion certificate. This is acceptable to the authority dealing with building regulation approvals and the architect takes full liability for the project. However, this almost never happens in housing!

Architects are rarely used on private sector housing projects. They often have an early role "up the chain" to provide the housebuilder with standard house types.

In social housing projects, architects are commonly employed by the design and build contractor to provide design services related principally to housing appearance. This can extend into technical detailing, but this is normally limited.

There will usually be a "below damp proof course (dpc)" structural engineer who will be responsible for soil assessment (for ground bearing capacity) and foundation design. If there were a requirement for special concrete slabs (rafts) or other concrete floors, the same engineer would normally carry out this work. The foundations engineer will rarely carry out timber structural calculations where specialist knowledge is required.

In timber frame housing, no matter what the floor area or the number of storeys, a structural engineer will be involved. Structural calculations for the timber frame are required by the authority dealing with building regulation approvals to demonstrate compliance with Part A of *The Building Regulations 2000*. In the UK, engineers who deal with timber design are specialists and relatively few in number. Calculations are not required for every individual house, but are needed for each **house type** in a particular wind speed area. The National House-Building Council (NHBC) also requires structural calculations for their warranty. This must be done by an engineer approved by NHBC. Fortunately, the same engineers are acceptable for Building Regulation calculations. Zurich Insurance Building Guarantees simply accept the Building Regulation calculations as submitted to Building Control.

For larger housing projects in the private sector, and for most social housing projects, a quantity surveyor is used as a pre-contract and contract administration cost consultant.

It is uncommon to employ mechanical and electrical engineers on UK housing projects. The mechanical and electrical work is usually "designed" and installed by sub-contract plumbers and electricians. It is rarely pre-planned or co-ordinated. Lack of knowledge about timber frame by these sub-contractors can result in structural damage due to excessive notching and drilling if the work is not monitored by someone with timber frame knowledge.

DIMENSIONAL DISCIPLINE AND CO-ORDINATION

The UK timber frame panel manufacturers pride themselves on their dimensional discipline and co-ordination, but it is an in-house discipline rather than industry wide. There are a number of disciplines that can be used such as:

- setting out to minimize cutting outer sheathing boards;
- setting out to minimize cutting interior linings; or
- setting out to brick cladding dimensions to minimize cutting bricks.

There are advantages in each of these options.

Whatever system is used, it relates on plan to studs at 400 mm or 600 mm based on the sheathing, lining and floor deck sheet materials; 2,400 mm long by 1,200 mm or 600 mm wide for wall and floor panel dimensions. For building planning with small area UK housing, a 400- or 600-mm grid is too coarse and a sub-grid of 100 mm is common. (A common "average house" is often taken as an 85 m^2 three bedroom house, interior footprint on ground of 43 m^2). This 100-mm grid works well for fixing items which follow later such as kitchen units.

For exporters, this is an extremely important point—that most (but not all) of UK construction works to metric dimensions. A 2,400 x 1,200 mm sheet is not the same as an 8' x 4' sheet—8' x 4' is 2,440 x 1,220 mm and will not work with the common UK 400 mm or 600 mm centres for studs or joists. An "imperial" system based on 8' x 4' sheets on framing at 16" (406 mm) or 24" (610 mm) centres is acceptable, but the exporter needs to be aware of the issues and make the decision rationally. As an example, if using the 610-mm grid, make sure the kitchen units will be on the same grid (kitchen units are normally in modules of 500 mm or 600 mm). Let the UK partners know what you are supplying or bring the kitchen units with you.

For vertical dimensional discipline there are also wide variations. This has become more confused in recent times as the use of deep timber I-joists has increased floor to floor dimensions.

The finished floor was normally the reference point and the floor-to-floor dimension was typically set at 2.6 m (230-mm floor zone with 2,370 mm floor to ceiling) which then became the standard timber stair height. The I-joists, at 241 mm or more deep, changed this and "special" stairs are now required. There is no minimum floor-to-ceiling height in any UK regulation but 2,300 mm is a typical "social" minimum.

There is a universal vertical dimension, which is that the head of all windows and exterior doors is set at 2,100 mm from the finished floor. This is mostly related to cladding brickwork coursing, where four bricks are equal to 300 mm.

Dimensional discipline and co-ordination is a large subject. Exporters should consider this early as it can avoid costly "metric-imperial" mistakes later in the UK.

GETTING STARTED! ON A REAL HOUSING PROJECT

GETTING STARTED! on a real housing project deals with the things that an exporter needs to know to start a specific project on site as opposed to type approvals for a product or system. The first step is applying for Building Regulation approval from the relevant local authority and approval from the housing warranty body if one is used. At present the National House-Building Council (NHBC) is the only approved body outside the local authority system (Building Control Group of the town, borough or city council).

It seems likely that most Canadian housing system exporters will partner with a local UK contractor and these approvals would normally be carried out by them. The following is a brief overview of the design and statutory procedures:

- Building Regulation applications are made in accordance with Regulation 12 which involves:
  - Giving the local authority a building notice in accordance with Regulation 13.
  - Depositing full plans with the local authority in accordance with Regulation 14.

- The latter is more common and involves submission of site and building plans, sections and elevations and calculations (e.g., U-values) with a fairly basic amount of detail and material specification, together with a fee. For timber frame, full structural calculations are also submitted (see *Section 3: Meeting the Building Regulations 2000 Performance Requirements* for more detail). In housing there is very minimal information submitted on services at this stage of the process. For the exporter, it is probably a matter of supplying the technical information and where necessary, approvals associated with the housing system or product.

- If the system or part system has an "independent type approval" for UK or European Union (EU) use (see *Section 4: Product and System Approvals and Certification Procedures* for types available), then this is submitted with some site-specific information from the contractor and the process is easier because of the "approval."

- To obtain a housing warranty, a builder must be registered with the relevant warranty body such as NHBC, which has some 18,000 registered builders or Zurich Insurance Building Guarantees which is smaller but nevertheless a significant player (they have included guidance on Super E® technology in their Technical Manual!). Since the Canadian exporter is likely to partner with a UK contractor who will be registered with the relevant body, it is not an issue for the exporter. In design and export terms, knowledge of the warranty technical standards is essential, but knowledge of the approval procedures is not. If the exporter is not partnering, then initial use of a local UK consultant may be considered to guide the exporter through the warranty standards.

EXPORTER NOTES: Before Getting Started

- **An architect who knows timber frame and the relevant Building Regulations is uncommon in the UK.**

- **Most exporters will be concerned with above damp proof course (dpc) systems and products, with a UK partner dealing with below dpc work. Exporters offering a full design service will need to consult a general "below dpc" engineer.**

- **A structural engineer will be needed for timber frame calculations. A Canadian engineer would be accepted provided the calculations were to the UK Code requirements.**

- **Access to a UK cost consultant, initially at least, is recommended.**

- **Pre-planning mechanical and electrical services is advantageous. Exporters may consider bringing Canadian specialist installers (e.g., for mechanical ventilation systems) to install initially and to train UK installers.**

- **Exporters should be aware that the UK is a metric country! It is also confusing as imperial measurements are still used in the building industry more than 30 years after metrification!**

- **Despite the widespread <u>verbal</u> use of imperial units, all setting out and most materials and components are metric ... but, bricks can be both and so can doors and windows.**

- **Exporters can use metric or imperial, but it is best to use one or the other. Mixing is usually wasteful in terms of cutting and is confusing. Make sure the UK partners know which dimensional discipline you are exporting.**

- **Most Canadian housing system exporters will partner with a local UK contractor and the warranty approvals would normally be carried out by them. If not, employing a UK architect or building surveyor would be recommended to assist with the design and statutory procedures associated with warranty provision.**

SECTION 3: MEETING THE BUILDING REGULATIONS 2000 PERFORMANCE REQUIREMENTS

As a Canadian exporter, you will need to know how to meet the requirements affecting:

- design for horizontal and vertical movement;
- foundations;
- ground floors;
- walls (exterior walls, interior loadbearing and non-loadbearing walls, and party walls);
- intermediate floors;
- roofs;
- windows, rooflights and doors; and
- services design and installation (including ventilation).

DESIGN FOR HORIZONTAL AND VERTICAL MOVEMENT

The relevant Parts of *The Building Regulations 2000* which define the performance requirements for movement (means of escape, disabled movement and stairs and barriers) for houses up to three storeys are:

- B - Fire safety
- K - Protection from falling, collision and impact
- M - Access and facilities for disabled people

Fire safety

Means of warning and escape

There is very detailed guidance in AD-B that is principally associated with house design in terms of layout planning rather than construction details. (*Getting Started!* assumes that exporters will not be involved in this level of design.) The key AD-B standards and approach to meeting the functional performance requirement of *B1 Means of warning and escape* are given in *Appendix 1*.

Protection from falling, collision and impact

This section of *The Building Regulations* 2000 will be of interest to exporters supplying interior house packages that include stairs, handrails and balustrading manufactured in Canada. The requirements for stairs and guarding in the NBC of Canada 1995 are very similar in principle and intent to those in the UK. However, there are small dimensional differences. General guidance on AD-K is given in *Appendix 1*. Exporters who wish to supply stairs may need further detail from AD-K.

Access and facilities for disabled people

There is detailed guidance in AD-M that mostly deals with exterior works to get to the house entrance and house design in terms of layout planning rather than construction details. (*Getting Started!* assumes that exporters will not be involved in this level of design.) The key AD-M standards and approach to meeting the functional performance requirement are given in *Appendix 1*. Some of the ways that UK designers meet these requirements are given here as they relate to door provision and servicing which may be an exporter issue. Exporters offering a full design service may need more detail from AD-M.

- An accessible threshold is provided at least at the front entrance to a house (accessible thresholds are increasingly specified at all entrances). An example is shown in Figure 6.
- To provide access for disabled people, exterior entrance doors have a minimum clear opening width of 775 mm.
- Corridor and door clear opening widths to habitable rooms or to rooms containing a water closet (WC) on the entrance storey are shown in Table 6 in *Appendix 1*.
- Switches and socket outlets for lights and power are located between 450 and 1,200 mm from floor level.
- A WC suitable for disabled people use in the entrance storey may be in a bathroom, but it is usually in a separate WC compartment.

EXPORTER NOTES: Design for Movement

- **Most exporters will not be concerned with detailed interior design work for means of egress. Exporters offering a full design service will need to consult AD-B1 in detail.**
- **Stairs and balustrade requirements in Canada are similar to those in the UK. Stairs for export will need to take into account the small dimensional changes in AD-K. Some strength testing or calculations for horizontal forces on guarding may be required.**
- **The level threshold approach at entrance doors may be new to exporters. In social housing this applies to all doors going to the outside at ground floor. For disabled movement at ground floors, door and corridor widths may be different to those used in Canadian design.**
- **The position of light and power switches is different in the Part M requirements and this applies to ALL housing at the ground floor.**

FOUNDATIONS

The relevant Parts of *The Building Regulations 2000* which define the performance requirements for foundations below the damp proof course (dpc) for houses up to three storeys are:

- A - Structure
- C - Site preparation and resistance to moisture

Timber frame construction normally starts above the damp proof course level. Basements are uncommon in the UK.

There will usually be a "below dpc" structural engineer who will be responsible for soil assessment (for ground bearing capacity) and the subsequent foundation design.

EXPORTER NOTES: Foundations

- **Most exporters will be concerned with above foundation systems and products with their UK partner dealing with below damp proof course work. Exporters offering a full design service will need to consult a general foundations engineer.**

GROUND FLOORS

The relevant Parts of *The Building Regulations 2000* that define the performance requirements for ground floors for houses up to three storeys are:

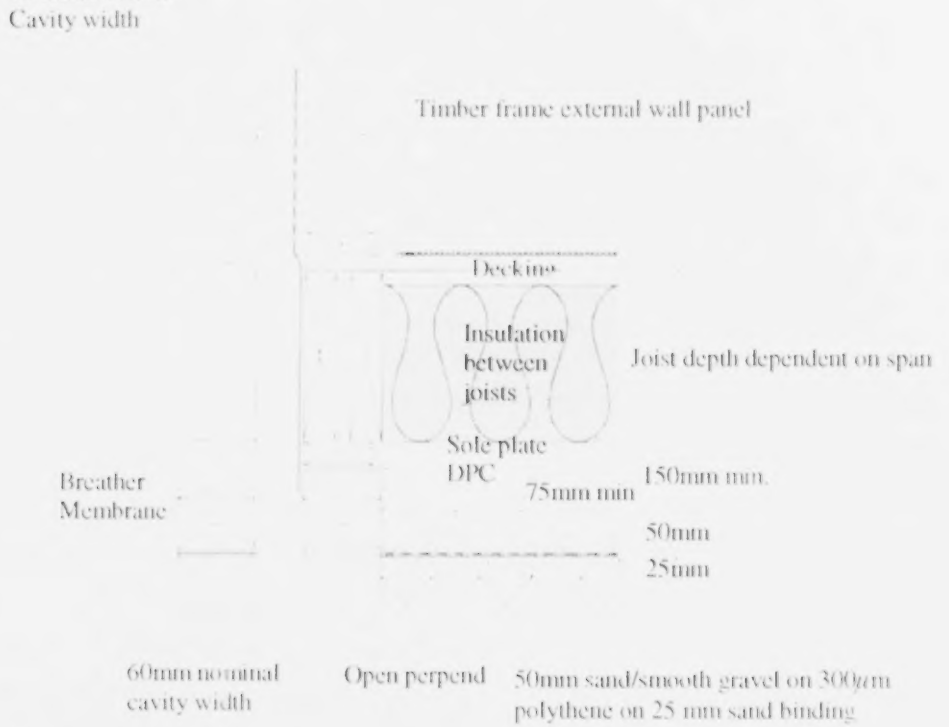
- A - Structure
- C - Site preparation and resistance to moisture
- L1 - Conservation of fuel and power in dwellings
- M - Access and facilities for disabled people

In England and Wales, a very high proportion of ground floors are concrete based. Where ground conditions allow (non-aggressive soil, stable against clay heave, reasonably flat) cast-in-place concrete slabs are used. In perhaps 70 per cent of cases, this is not possible and pre-cast concrete floors are used. In either case, it is unlikely that Canadian exporters will be involved in this market. If exporters are supplying onto a cast in-situ or pre-cast concrete floor the starting point is likely to be the sole plate above the dpc on top of the concrete. A sole plate is an horizontal lumber member fixed down to the foundation which forms a base template for all the house walls. The bottom rails of the timber panels are fixed down to the sole plate.

The rest of this section considers wood frame floors above the crawlspace (timber suspended ground floors). Figure 1 shows a typical UK timber suspended ground floor. The construction principles are similar to those used in Canada.

NOTE: Changes in the thermal insulation standards, Part L1 may result in an increased market share for timber suspended ground floors as they are easier to insulate than concrete alternatives.

Figure 1: Timber Suspended Ground Floor



Structure

The structural design of timber suspended ground floors in the UK is carried out by approved structural engineers in accordance with BS 5268: Part 2. As an alternative, Eurocode 5 can be used for all structural lumber (timber) design.

The authority responsible for assessing compliance with *The Building Regulations 2000*, Part A usually requires full structural calculations.

Canadian strength-grades and timber species combinations to National Lumber Grades Authority (NLGA) are listed in BS 5268 and are known and accepted for structural lumber use in the UK.

Floor joists spanning 2.5–4.5 m require one row of bridging (strutting) at mid-span. Spans of more than 4.5 m need two rows of strutting at one-third span positions. Struts can be timber herringbone 38 x 38 mm or 38 mm solid timber struts at least 0.75 joist depth. Metal herringbone strutting may also be used.

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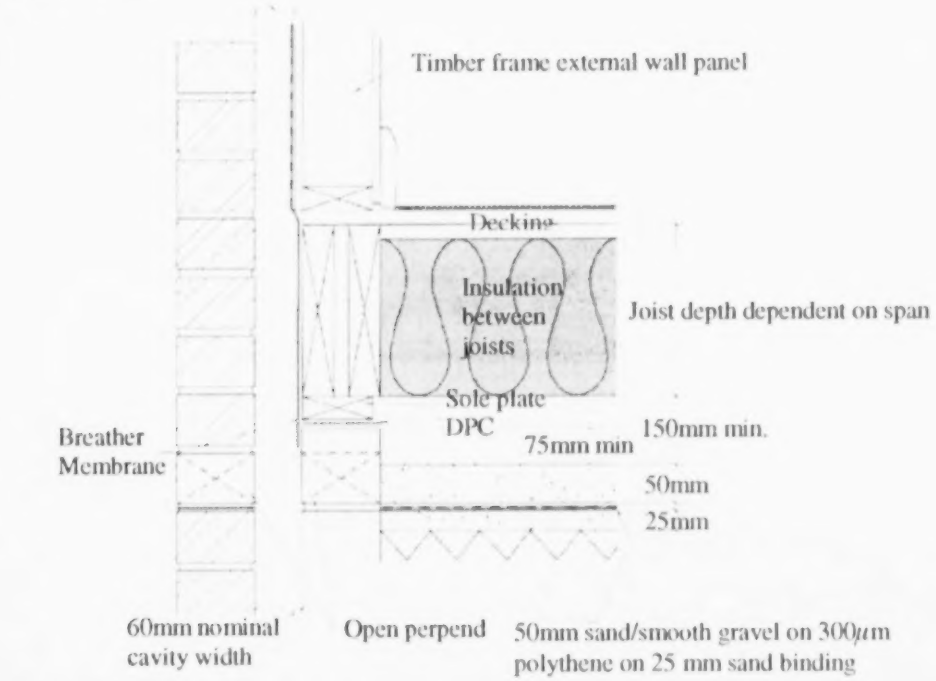

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The floor decking materials in use in the UK are chipboard (sometimes called **particleboard** in Europe as in Canada), oriented strand board (OSB) and plywood. Chipboard Type P5 to BS EN 312-5 or Type P7 to BS EN 312-7 is the predominant decking material. OSB Type 3 to BS EN 300 has some market share but is not common. Plywood for floor decking is rare at present due to the competitive price of chipboard and OSB in the UK.

The chipboard or OSB should be protected from short term wetting with a peel-off waterproof film or with some alternative protection and all joints taped after the deck is fixed. An expansion gap should be provided for chipboard or OSB at the room perimeter and where it butts against any fixed vertical member (upstand). Plywood can be laid at any time without extra protection, does not need an expansion gap and can be run through to the perimeter under the timber frame wall panels.

It is not certain that:

- Canadian chipboard would meet BS EN 312-5 or –7: and
- Canadian OSB would meet BS EN 300.

These may need to be tested if equivalence cannot be established.

Structural plywood for floor decking should be one of the plywoods listed in BS 5268: Part 2. The plywood should be subject to third party quality assurance by one of the bodies included in BS 5268: Part 2. Canadian plywood is listed in BS 5268: Part 2 with Council of Forest Industries (COFI) as the assurance body. It is proven and accepted in the UK for floor decking.

For joists at 600 mm centres, chipboard decking would be 22 mm and OSB or plywood would be 18 mm. For joists at 400 mm all decking is typically 18 mm thick.

It is a British Standard requirement that the decking is glued to the supporting joists and that all tongued and grooved joints are glued. This is different to Canadian practice.

Site preparation and resistance to moisture

Timber ground floor joists are usually supported on a timber sole plate. A 0.5-mm ribbed polyethylene (polythene) strip damp proof course is normally laid below the timber sole plates to prevent water rising from the foundation into the floor joists and walls above.

To ensure that the timber is protected from ground water and high humidity the underfloor treatment is typically:

1. a ground cover of 50 mm inert fine aggregate (sand or smooth gravel) or concrete of mix ST1 to BS 5328 on 0.3 mm polyethylene 0.25 mm if independently assessed; the detail should ensure that water does not collect on top of the ground cover; and,
2. a ventilated air space at least 150 mm from the top of the ground cover to the base of joists and 75 mm to the base of wall plates; and,
3. ventilation openings equivalent to 1500 mm^2 per metre run of two opposite exterior walls.

Conservation of fuel and power in dwellings

The relevant Part of the Regulation for ground floors in housing up to three storeys is "
...(a) limiting the heat loss through the building fabric;..."

This is done in Approved Document L1 by setting a maximum "U-value" for ground floors. The U-value for the compliance with the Elemental Method of AD-L1 is 0.25 W/m^{2}K (R_{metric}=4.00 m^{2}K/W; $R_{imperial}$=22.7).

The actual floor U value is dependent on the ratio of exposed floor perimeter to floor area. For a typical three bedroom 85 m^2 detached house (8.5 m x 5 m), the Elemental U value of 0.25 W/m^{2}K is easily achieved by installing 200 mm of mineral wool (glass or rock with a thermal conductivity of 0.04 W/mK) between the timber joists. In the UK it is common to support this insulation in a trough formed by draping breather membrane or plastic netting between the joists.

There is an AD-L1 requirement that the building fabric should be constructed so there are no significant thermal bridges or gaps in insulation within the building elements, at joints and at the edges of elements. AD-L1 also requires that reasonable provision should be made to reduce unwanted air leakage. However, the need for adequate room ventilation should be taken into account. Acceptable details are given in the document *Limiting Thermal Bridging and Air Leakage: Robust construction details for dwellings and similar buildings* (2001) The Stationery Office. Current UK timber frame easily meets these requirements. The floor details from Canada would easily exceed these new standards (it is effectively an air leakage standard of 6 ACH at 50Pa).

Access and facilities for disabled people

Approved Document M requires that at least the principal entrance to all new housing should be accessible to disabled people. This effectively means that the threshold should be level to facilitate entry for wheelchair users.

A typical accessible threshold for a UK timber suspended ground floor is shown in Figure 6 in the later section on doors.

EXPORTER NOTES: Ground Floors

- **Canadian exporters should have no difficulty meeting the Part A floor design standards but structural calculations will be needed.**
- **National Lumber Grades Authority (NLGA) graded timber and Council of Forest Industries (COFI) stamped plywood are accepted.**
- **Canadian OSB and chipboard (particleboard) may need testing. They also may need weather protection if used for floor decking. The deck must be glued to the joists and at the tongue and groove joints.**
- **It is simple and economic to meet the AD-L1 U value for timber suspended ground floors and exporters would not have to make major changes to existing construction details. Current Canadian floor details would normally meet the requirement to limit thermal bridges. There may be a marketing edge to increase the floor insulation in timber suspended ground floors and the cost of upgrading is low.**

- **Most of the work associated with level thresholds is outside the building and is likely to be the responsibility of the exporter's partner. Exporters could provide the special door threshold but this may be different to most Canadian thresholds.**

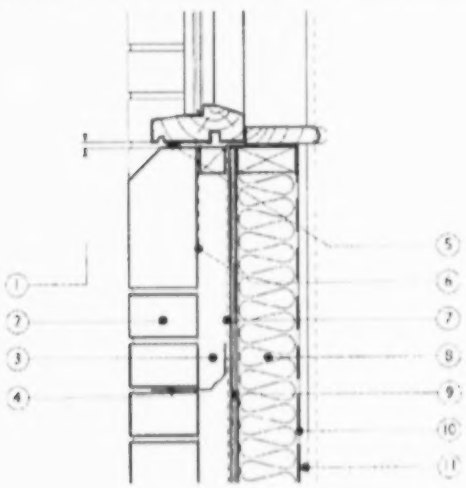
WALLS

The relevant Parts of *The Building Regulations 2000* that define the performance requirements for exterior walls, interior loadbearing walls, interior non-loadbearing walls and party walls for houses up to three storeys are:

- A - Structure
- B - Fire safety
- C - Site preparation and resistance to moisture
- E - Resistance to the passage of sound
- L1 - Conservation of fuel and power in dwellings
- Regulation 7
  - Timber preservative pre-treatment
  - Condensation control

Figure 2 illustrates a typical UK timber frame exterior wall. This is essentially the same as a Canadian wood frame exterior wall.

Figure 2: Typical UK Timber Frame Exterior Wall



1. differential movement gap
2. brick cladding
3. 50 mm cavity
4. stainless steel wall ties
5. flexible sealant
6. damp proof course
7. breather membrane
8. timber frame with insulation in the frame space
9. wood-based sheathing board
10. vapour control layer
11. plasterboard lining

Figure 3 illustrates a typical UK timber frame loadbearing interior wall. An interior non-loadbearing wall is the same except the stud depth is not defined by structural needs. Again, this is essentially the same as a Canadian wood frame loadbearing or non-loadbearing interior wall.

Figure 3: Typical UK Timber Frame Loadbearing Interior Wall

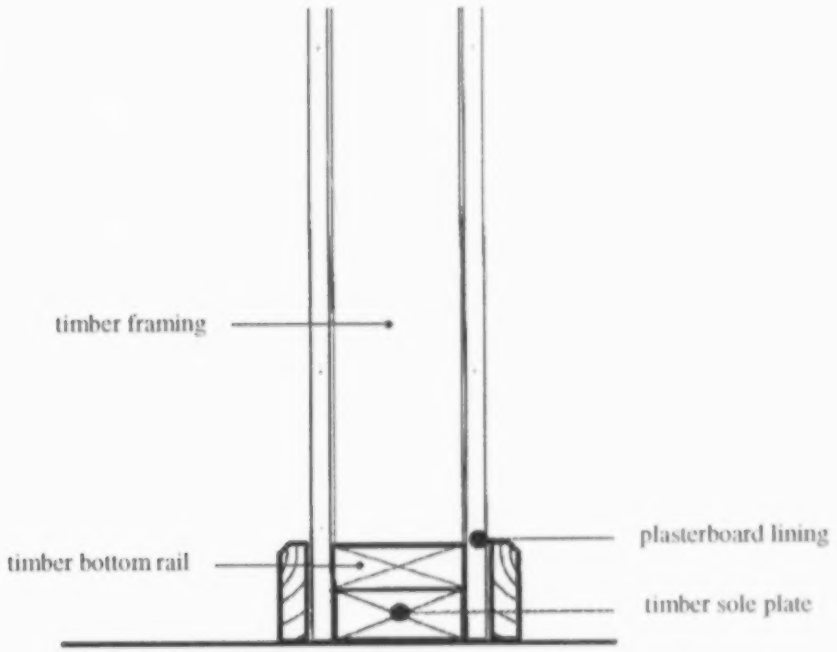
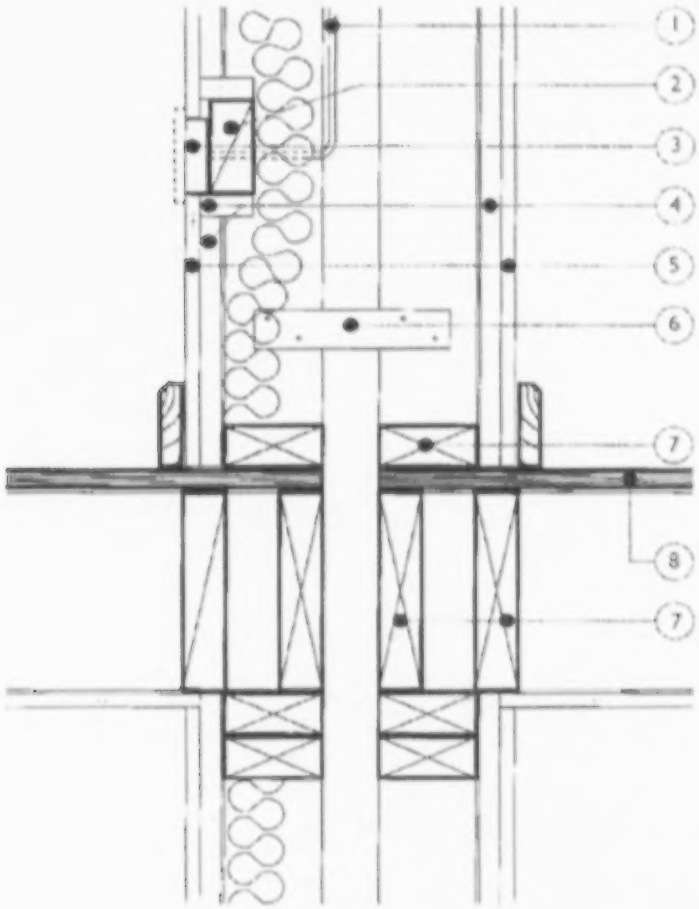


Figure 4 illustrates a typical UK timber frame party wall specified between houses in separate occupancy. This is similar to the Canadian frame wall "W15f" in Table A-9.10.3.1.A in the National Building Code of Canada 1995.

Figure 4: Typical UK Timber Frame Party Wall



1. electrical fittings
2. timber nogging
3. electrical fittings
4. 19 mm plasterboard
5. 12.5 mm plasterboard
6. metal strap
7. timber floor joists, and in the wall, timber rails and studs
8. wood-based panel floor deck

Structure

The structural design of all timber frame loadbearing walls in the UK is carried out by approved structural engineers in accordance with BS 5268: Part 2 for vertical loads and BS 5268: Part 6: Section 6.1 for horizontal loads. As an alternative, Eurocode 5 can be used for all structural timber design.

The authority responsible for assessing compliance with *The Building Regulations 2000*, Part A usually requires full structural calculations.

The majority of lumber for framing exterior walls in the UK has for many years been 89 x 38 mm strength-graded softwood with studs at either 400 mm or 600 mm; the latter being the most common. Changes in Part L1 of the regulations may result in the use of other larger sections.

Canadian strength-grades and lumber species combinations to NLGA are listed in BS 5268: Part 2 and are known and accepted for structural use in the UK.

The panel sheathing materials in use for wind bracing in the UK are OSB, fibreboards and plywood. OSB Type 3 has in excess of 90 per cent of the sheathing market at present. Fibreboards such as impregnated softboard and waxed mediumboard have a small market share. Plywood is rare at present due to the competitive price of OSB in the UK.

OSB for wall sheathing should be OSB-3 or OSB-4 to BS EN 300. Plywood for wall sheathing should be one of the plywoods listed in BS 5268: Part 2 and subject to third party quality assurance by one of the bodies included in BS 5268: Part 2. Canadian plywood is accepted.

Fire safety

Internal fire spread (linings)

The interior finish (linings) of walls in houses up to three storeys generally need to have a surface classification of Class 1 Surface Spread of Flame including walls in garages and circulation spaces.

For most conventional UK applications gypsum wallboard (plasterboard) is used as the interior lining for frame walls. This wallboard meets the Class 1 surface requirements.

Lumber may be used as a wall lining material. Lumber or wood sheet materials with a density of more than 400 kg/m^3 have a Class 3 classification. Western red cedar is below 400 kg/m^3 and does not have any classification. ALL lumber can be upgraded to Class 1 by impregnation or surface treatments. If lumber is used as the lining, there must still be sufficient gypsum plasterboard beneath the outer lining to meet the fire resistance requirements or, fire resistance must be assessed in some other way e.g.; lumber charring rates.

Internal fire spread (structure)

Exterior frame walls in three storey housing are required to have a fire resistance of 30 minutes in all cases when exposed to fire from inside. Exterior walls within one metre of a boundary are also required to have a fire resistance of 30 minutes when exposed to fire from outside the building. For three-storey housing, this external fire resistance requirement applies to exterior walls within one metre either side of the party wall in semi-detached or terraced housing.

Table 1: Tested walls that meet fire resistance requirements-1

TYPE OF WALL	STRUCTURE	REQUIREMENT	CRITERIA
Exterior	❑ 38 mm wide (at least) studs ❑ 12.5 mm gypsum board interior lining ❑ mineral wool (glass, rock or slag) or cellulose fibre insulation ❑ 9 mm (or more) OSB or plywood sheathing	30 minute fire resistance from inside	❑ loadbearing capacity ❑ integrity ❑ insulation

If the house is masonry clad or cement render clad, the 30 minute fire resistance requirement from outside is normally taken care of with these claddings and the timber frame as above. If wood or other combustible light claddings are used, the simple option is to add a layer of 12.5 mm moisture-resistant gypsum board to the outside of the OSB or plywood sheathing for the zone within one metre of the boundaries. The cladding is considered sacrificial.

Loadbearing interior frame walls in three storey housing are required to have a fire resistance of 30 minutes in all cases when exposed to fire from each side separately. The requirement is for loadbearing capacity only. There is no requirement for integrity or insulation.

Table 2: Tested walls that meet fire resistance requirements-2

TYPE OF WALL	STRUCTURE	REQUIREMENT	CRITERIA
Interior	❑ 38 mm wide (at least) ❑ 12.5 mm gypsum board linings on both sides	30 minute fire resistance from inside	❑ loadbearing capacity

There are no fire resistance requirements for interior non-loadbearing timber frame walls.

Party walls in houses up to three storeys are required to have a fire resistance of sixty minutes in all cases when exposed to fire from each side separately. The requirement is for loadbearing capacity (when the wall is taking vertical loads), integrity and insulation.

Table 3: Tested walls that meet fire resistance requirements-3

TYPE OF WALL	STRUCTURE	REQUIREMENT	CRITERIA
Party	❑ double leaf wall ❑ 38 mm wide (at least) studs in both leafs ❑ 30 mm (at least) gypsum board lining min on each of the 2 stud walls	60 minute fire resistance from each side separately	❑ loadbearing capacity (when the wall is taking vertical loads) ❑ integrity ❑ insulation

It is almost universal practice in the UK to install a 19-mm plasterboard plank directly to the walls, with a 12.5-mm plasterboard sheet, with joints staggered, laid over the plank to the inside. Two layers of 15-mm plasterboard will give the same fire resistance. With both layers of the same thickness the sound insulation will be slightly reduced, but this wall exceeds the AD-E requirements by so much that this will not be a problem.

In the roof space above the top floor ceiling, the plasterboard lining to each side of triangular spandrel walls can be reduced to 25 mm, usually two layers of 12.5 mm board fixed with joints staggered.

Provision of cavity barriers
Housing up to three storeys should be designed and constructed so that the unseen spread of fire and smoke in concealed spaces (cavities) is inhibited. This is done by closing the cavity between the timber frame and the cladding at certain locations to limit the area of fire spread.

The requirements for cavity barriers in exterior walls are:
- horizontal at eaves and at the ceiling line of gables (or at the verge line);
- vertical at the party walls;
- around all openings.

Cavity barriers are most commonly:
- lumber at least 38 mm thick in any direction (usually 50 mm in brick cavities);
- polyethylene sleeved mineral wool "sausages" fitted under compression in the cavity;
- the door or window frame itself may be able to act as a cavity barrier.

In the UK, with masonry cladding the cavity barriers around openings are usually 50 x 50 mm lumber and those at the eaves and party walls are normally the "sausages." It is acceptable to use lumber in all locations.

With claddings such as wood or cement render on laths, the lumber battens, which form the drained and vented cavity behind the cladding, normally also act as the cavity barriers.

External fire spread
Any part of an exterior wall to a house closer than one metre to the boundary is required to have a Class 0 surface spread of flame to the exterior surface. This requirement applies only to the part of the surface in the one metre zone on either side of the boundary (usually from the centreline of the party wall). The requirement applies to the top of a party wall where there is a step between adjacent houses. This requirement also applies to soffits at roof eaves. A calcium silicate board is often used for soffits but treated wood or wood panel products can also be used.

If the house is masonry clad, cement render clad or has any other non-combustible cladding (e.g., tile or slate hanging), the surface will be Class 0. If wood or a wood panel product cladding is used, it can be upgraded to Class 0 by impregnation with a "humidity resistant" treatment (i.e., a treatment, which does not leach from the timber due to wetting or too high exterior relative humidity). Surface-applied treatments are not considered adequate for exterior use. The requirement for humidity resistance also applies to soffits. If other non-combustible claddings are considered, then specialist advice should be sought from the supplier in terms of Class 0 surface spread of flame.

Site preparation and resistance to moisture

Walls should be protected from ground moisture by the use of damp proof courses.

A 0.5-mm ribbed polyethylene strip damp proof course is normally laid below the sole plates, below frame wall panels to prevent water rising from the foundation into the timber structure. The strip is commonly lapped with the floor damp proof membrane to provide damp proofing continuity over the whole structural footprint of the house.

Cladding for exterior walls should have overlapping dry joints, be impervious or weather-resisting, and be backed by a material which directs water or snow coming through the cladding back to the outer face (i.e., a drained and vented cavity).

In the UK, all housing has a cavity between the outer, non-structural cladding and the inner structural system. In timber frame this is called a drained and vented cavity.

- The cladding is the first line of defence against rain or snow penetration. It is normally accepted that some rain will penetrate all claddings.
- The cavity is the second line of defence and any rain that penetrates the cladding drains down the inside face of the cladding and is directed back to the outside.
- All cavities are open at the base in some way to ensure drainage. The openings are protected to prevent the ingress of insects.
- In timber frame, the breather membrane forms a third line of defence and protects the wall from any water which may be driven across the cavity (this is rare but can occur in exposed western locations). A breather membrane is waterproof but is highly permeable to the diffusion of water vapour. These are essentially the same as Canadian breather "papers" but some testing may be required—these are simple tests to BS 4016. (see also the section below on condensation control under Regulation 7 in walls)
- Window-to-wall or door-to-wall openings are protected with flashings and or compressible seals.

Typical cladding and cavity relationships are shown in Table 4:

Table 4: Claddings and cavities for timber frame housing

CLADDING TYPE	CAVITY REQUIREMENTS
Brickwork	50 mm+/-10 mm
Timber-horizontal boards	15-mm vertical battens
Timber-vertical boards	15-mm vertical battens plus 15-mm horizontal battens all at max. 600 mm spacing
Timber-board on board	15-mm horizontal battens at max. 600 mm spacing with top face angled to outside
Cement render- stainless steel lath backed by breather membrane	25-mm vertical battens at max. 600 mm spacing
Cement render- stainless steel lath not backed	50-mm vertical battens at max. 600 mm spacing
Tile or slate hanging	15-mm horizontal batten at max. 600 mm spacings with top face angled to outside
Other claddings	Minimum 15 mm and ensure vertical drainage to base and outside

Resistance to the passage of sound

A prescriptive two leaf (double stud) timber frame wall (wall Type 4A) is shown in AD-E as deemed to meet the requirement. This is the wall shown in Figure 4.

In the roof space above the top floor ceiling, the mineral wool sound absorbing insulation to one side of spandrel walls can be omitted.

This is similar to wall "W15f" in Table A-9.10.3.1.A in the National Building Code of Canada 1995. The detailed differences are that the plasterboard arrangement is varied to 31.5 mm (19 + 12.5 mm) and the insulation in at least one leaf should be at least 10 kg/m^3. Two 15-mm plasterboard layers would give similar results to those tested values given below.

This wall has been consistently tested to give a sound reduction index of 60-65 dB.

Conservation of fuel and power in dwellings

The relevant Part of the Regulation concerning exterior walls in housing up to three storeys is *"...(a) limiting the heat loss through the building fabric;..."*

This is done in Approved Document L1 by setting a maximum "U-value" for walls. The U-value for the compliance with the Elemental Method of AD-L1 is 0.35 W/m^{2}K (R_{metric}=2.86 m^{2}K/W; $R_{imperial}$=16.2).

Conventional timber frame walls in the UK have used 89 mm deep studs, typically filled with mineral wool insulation (rock or glass with a thermal conductivity of 0.04 W/mK). This results in a U-value of around 0.40 W/m^{2}K (R_{metric}=2.5 m^{2}K/W; $R_{imperial}$=14.2) when the value is corrected for 15 per cent of the wall area as timber frame (studs, rails, lintels etc.). Timber frame walls therefore had to change in April 2002 to meet the new 0.35 W/m^{2}K U-value. These changes are considered by

many in the housebuilding industry to be easier and less costly than those needed for masonry construction.

The UK timber frame industry and the housebuilder clients have not reached a consensus view on the best change option to meet the AD-L1 requirement for exterior walls. The four main options under review are:

- Use deeper studs with more mineral wool in the frames.
- Retain 89-mm studs and use phenolic or urethane in the frames.
- Retain 89-mm studs and use a thin exterior phenolic or urethane with mineral wool in the frames.
- Retain 89-mm studs and use an exterior reflective membrane with mineral wool in the frames.

It is not certain which option the UK timber frame industry will choose. It may ultimately be driven by housebuilders and clients and the timber frame manufacturers will simply have to supply what is specified.

There is an AD-L1 requirement that the building fabric should be constructed so there are no significant thermal bridges or gaps in insulation within the building elements, at joints and at the edges of elements. AD-L1 also requires that reasonable provision should be made to reduce unwanted air leakage. However, the need for adequate room ventilation should be taken into account. Acceptable details are given in the document *Limiting Thermal Bridging and Air Leakage: Robust construction details for dwellings and similar buildings*. Current UK timber frame easily meets these requirements. The wall details from Canada would easily exceed these new standards (it is effectively an air leakage standard of 6 ACH at 50Pa).

Regulation 7

Timber preservative pre-treatment

The Building Regulations are not specific about timber preservative pre-treatment for timber in exterior walls, but many local authorities adopt the housing warranty body guidance as part of Regulation 7. The NHBC is the leading warranty provider and they are now a major competitor to local authorities in assessing and administering Building Regulation approval. This has reinforced the notional mandatory status of pre-treatment. The typical pre-treatment regime can be summarized as follows:

- If the exterior wall structural timber species is naturally durable and all sapwood is excluded, then no preservative treatment would be required. This is an unlikely scenario.

- Conventional UK timber frame almost always uses non-durable softwoods for exterior wall framing; in Canadian terms, typically a spruce/pine/fir or maybe hem/fir species group. These exterior wall structural timbers are required by warranty bodies to be preservative pre-treated.

- Timber elements which comprise an exterior wall and which require treatment under warranties are:
  - sole plates;
  - timber studs and rails;
  - head binders;
  - header joists;
  - lintels; and
  - cavity barriers.

- The treatment process may be copper-chrome-arsenic (CCA) to BS 4072; double vacuum organic solvent (OS) to BS 5707:Part 1 or boron salt diffusion as in the *British Wood Preserving and Damp Proofing Association* (BWPDA) *Manual*.

- Currently, most UK frame manufacturers use CCA for sole plates and an OS process for all the other framing. There is a certain level of replacement of OS product with what is called a mixed emulsion process—a combination of a low water content and a small amount of solvent with the active chemicals. This is seen as a greener option than a process using full solvent carriers. Also in pursuit of greener options, CCA is beginning to be replaced by "copper azole" which also includes some boron salts. There is only very limited use of boron salt diffusion although this is considered the "greenest" option. It is known that CCA is being phased out in Canada. This will not be a problem as the sole plates can be treated or protected in other ways.

Some suppliers of new and innovative timber frame systems have recently made a case that preservative treatment is not required for their system. This is typically based on an assertion that the detailing and assembly procedures are designed to avoid extended wetting of the timber frames. Imported frames may be able to make a similar case but, if it is largely "conventional frame" similar to the UK platform frame, the case may be difficult.

Condensation control
The risk of interstitial condensation is not covered in any other Part of *The Building Regulations 2000* so it falls by default under Regulation 7.

The control of winter interstitial condensation in timber frame exterior walls is simple. In UK housing there is a higher vapour pressure inside than there is outside in winter, so that the water vapour from inside tends to move outward. Provided that the interior water vapour can escape faster through the construction layers outside the insulation than it can enter the layers inside the insulation, there will be no net build-up of water vapour inside the wall construction and no interstitial condensation. As a rule of thumb, the vapour resistance for the inside layers should be at least five times that of the vapour resistance of the outer layers.

In UK timber frame it is common to use either a vapour control proprietary plasterboard (typically a metallized plastic layer on the back face) or a 0.12-mm polyethylene vapour control layer (this is the same as a polyethylene vapour barrier in Canada) on the inside with an OSB sheathing and a breather membrane on the outside. The cladding and the drained and vented cavity do not normally come into the equation as the venting action means that the cavity and exterior air are at equal vapour pressure. This gives an inside to outside vapour resistance ratio of about 50:1 for the polyethylene option and 12:1 for the vapour control plasterboard option. Other vapour control approaches such as special paints may be equally acceptable.

An interior layer to exterior layer water vapour resistance ratio of less than 5:1 may be acceptable. In such cases, a calculation of condensation risk in accordance with BS 5250 will be required.

EXPORTER NOTES: Walls

- **Canadian exporters should not have any difficulty meeting the Part A wall standards but structural calculations will be needed.**
- **Gypsum board is commonly used in the UK and will meet the fire spread requirements whether it is a Canadian, UK or EU product.**
- **Exporters can use wood as a wall finish as it can be upgraded to Class 1 by surface or impregnation treatment. If wood is used as the wall lining the fire resistance performance must not be compromised.**
- **The basic frame walls are the same as those used in Canada, but will need changes to meet fire resistance requirements.**
- **Cavity barriers will be new to Canadian exporters.**
- **There should be no problem in using UK brick cladding with any Canadian housing system. Tile or slate hanging will easily attach to a Canadian system. Exterior lumber cladding will likely need flame retardant pre-treatment. Any other cladding (e.g., asphalt shingles) should be assessed early to ensure it is suitable for use near boundaries.**
- **Frame housing without a drained and vented cavity is unlikely to be accepted in the UK.**
- **If exporters intend to design and supply cladding, they will need to develop construction details that demonstrate resistance to weather.**
- **Detailing at the edge of the wall is important and if inadequate , can impair the sound insulation.**
- **Standard Canadian details would typically give a more airtight construction than UK timber frame walls. Limiting air leakage may be a marketing advantage.**
- **Exporters should assume that exterior wall lumber will require preservative treatment. Negotiations by Canadian authorities may result in removal of the treatment requirement for exporters. In the UK preservative typically increases timber cost/m^3 by 10 per cent.**
- **Current Canadian frame walls will meet the "5x rule" for condensation risk.**
- **The Canadian practice of sealing vapour control layers (which is normally also the air barrier) will always be better than normal UK practice. Exporters can use a different arrangement for vapour resistance layers but a calculation will be needed. There are a number of UK calculation programs.Current Canadian frame walls will meet the "5x rule" for condensation risk.**

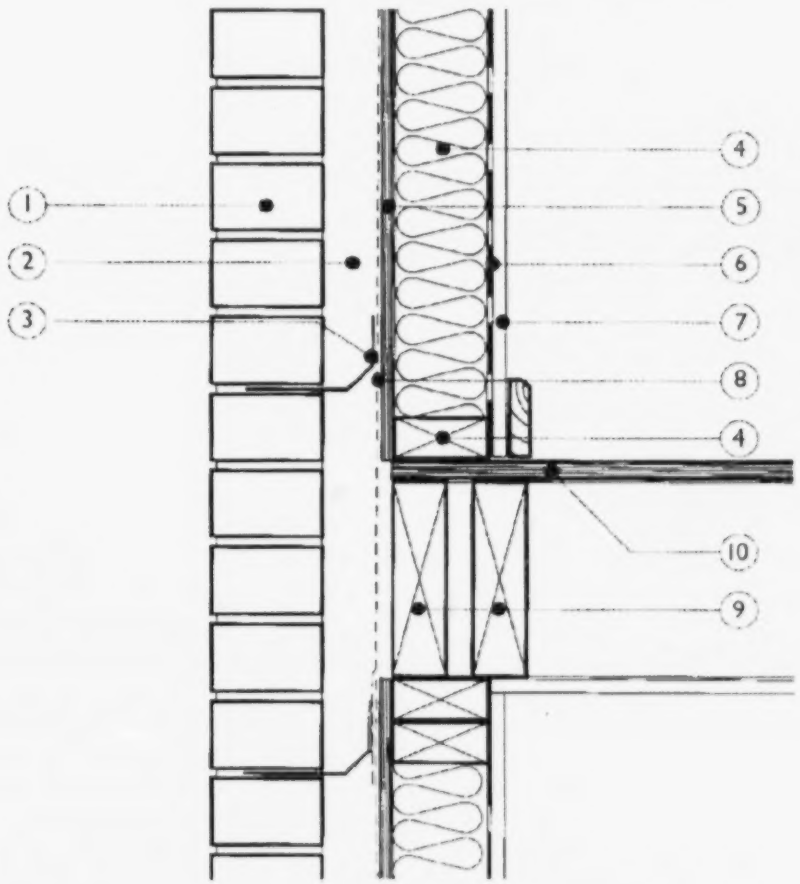
INTERMEDIATE FLOORS

The relevant Parts of *The Building Regulations 2000* that define the performance requirements for intermediate floors for houses up to three storeys are:

- A - Structure
- B - Fire Safety
- Regulation 7

Figure 5 shows a typical UK timber intermediate floor. The construction principles are very similar to those for the intermediate floors common in Canada.

Figure 5: Timber Intermediate Floor



1. brick cladding
2. 50 mm cavity
3. stainless steel wall tie
4. timber framing with insulation between
5. wood-based sheathing board
6. vapour control layer
7. plasterboard lining
8. breather membrane
9. timber floor joists with plasterboard ceiling below
10. wood-based panel floor deck

Structure

Approved structural engineers carry out the structural design of timber intermediate floors in the UK in accordance with BS 5268: Part 2. As an alternative, Eurocode 5 can be used for all structural lumber design.

The authority responsible for assessing compliance with *The Building Regulations 2000*, Part A usually requires full structural calculations.

Canadian strength-grades and lumber species combinations to NLGA are listed in BS 5268: Part 2 and are known and accepted for structural lumber use in the UK.

Floor joist strutting is the same as for ground floors.

The floor decking materials for intermediate floors are the same as for ground floors.

Fire safety

Internal fire spread (linings)

The ceiling linings of intermediate floors in houses up to three storeys generally need to have a surface classification of Class 1 Surface Spread of Flame including ceilings to circulation spaces.

For most conventional UK applications gypsum wallboard is used as the ceiling lining for intermediate floors. This will meet the Class 1 surface requirements.

Lumber may be used as a ceiling lining material (see requirements for *Walls*).

Internal fire spread (structure)

Intermediate floors in three-storey housing are required to have a fire resistance of 30 minutes in all cases when exposed to fire from below.

Tests have established that a timber intermediate floor with...

- joists at least 38 mm wide,
- a 12. 5-mm gypsum board ceiling lining, and,
- a 15 mm (or more) chipboard, OSB or plywood decking ...

... will satisfy the 30 minute fire resistance requirement from below for each of the three criteria: loadbearing capacity, integrity and insulation.

Regulation 7

Timber preservative pre-treatment

The Building Regulations are not specific about preservative pre-treatment for lumber in intermediate floors but many local authorities adopt the housing warranty body guidance as part of Regulation 7.

Header joists and edge joists in platform floors may need to be treated. Treatment options are given in the *Walls* section.

EXPORTER NOTES: Intermediate Floors

- **The basic UK frame intermediate floor is essentially the same as that used in Canada.**
- **Canadian exporters should have no difficulty meeting the Part A floor design standards, but structural calculations will be needed.**
- **It is common to use gypsum board as the ceiling finish for intermediate floors in housing. This will meet the surface requirements in the UK whether the gypsum board used is a Canadian, UK or EU product.**
- **Exporters can use lumber as a ceiling finish as it can be upgraded to Class 1 by surface or impregnation treatment. If lumber is used as the ceiling lining the fire resistance performance must not be compromised.**
- **Exporters will not need to change their floor details to meet 30-minute fire resistance from below.**
- **Header and edge joists may need preservative pre-treatment.**

ROOFS

The relevant Parts of *The Building Regulations 2000* that define the performance requirements for roofs for houses up to three storeys are:

- A - Structure
- B - Fire safety
- C - Site preparation and resistance to moisture
- F - Ventilation
- L1 - Conservation of fuel and power in dwellings
- Regulation 7
  - Timber preservative pre-treatment

Structure

Trussed rafters should be designed in accordance with BS 5268: Part 3. Rafter suppliers normally provide calculations for trussed rafters as part of the supply package.

Other structural roof elements, such as loose rafters or roof panels, should be designed by an approved structural engineer in accordance with BS 5268: Part 2. As an alternative, Eurocode 5 can be used for all structural lumber design.

The authority responsible for assessing compliance with *The Building Regulations 2000*, Part A usually requires full structural calculations.

Canadian strength-grades and lumber species combinations to NLGA are listed in BS 5268 and are known and accepted for structural use in the UK.

Trussed rafter roofs are not sheathed with OSB or plywood for wind bracing in England and Wales. Solid lumber boards, usually 100 x 25 mm are used for bracing in the longitudinal direction, tied back to gables, and diagonally. The trussed rafter supplier normally provides the bracing layout as it is in Canada. It is common practice in Scotland for trussed rafter roofs to be sheathed with OSB or plywood, which eliminates the need for diagonal bracing boards. This would also be accepted in England and Wales.

When roof panels are used to create habitable space in the attic, the panel sheathing materials in use in the UK are OSB, fibreboards and plywood. OSB Type 3 is the most common roof sheathing. Fibreboards such as impregnated softboard and waxed mediumboard have a small market share. Plywood is rarely used due to the competitive price of OSB.

OSB and plywood for roof sheathing has all the same strength grade and quality requirements as for floor decking or wall sheathing.

Fire safety

Internal fire spread (linings)

The ceiling linings of roofs in houses up to three storeys generally need to have a surface classification of Class 1 Surface Spread of Flame including ceilings to circulation spaces. Surface Spread of Flame Classification is tested in accordance with BS 476 Parts 6 or 7.

For most conventional UK applications gypsum wallboard is used as the ceiling lining for timber roofs. This wallboard will meet the Class 1 surface requirements.

Lumber may be used as a ceiling lining material (see *Floors*).

Internal fire spread (structure)

There are no Building Regulation requirements for fire resistance in roofs where the insulation is at the flat ceiling level. Where the attic space is used as habitable space, the floor below the space and the wall parts of the attic are required to have the same 30 minute fire resistance as other walls and floors in housing up to three storeys.

For traditional rafter and purlin roofs and for panel roofs, the fire resistance is achieved in the same way as for walls and floors i.e.; the gypsum wallboard ceiling, the lumber structure and the floor deck (see *Walls* and *Floors*). In the case of attic trussed rafters, additional fire precautions are needed to protect the metal nail plates. This is typically done by protecting them with plasterboard

or mineral wool. The plasterboard is a little bigger in area than the plates and is nailed to the truss to cover and protect the plate surface. Mineral wool is friction- fitted to cover and protect the face of the plates. The nail plate protection is not required in trussed rafter roofs where the attic space is not habitable.

External fire spread
The type of roof covering allowed is related to the surface spread of flame classification and to the distance from the boundary. Roof coverings designated AA, AB or AC when tested in accordance with BS 476: Part 3 will be acceptable for any boundary distance.

The following roof claddings are designated as AA and may be used on any roof, including on the notional party wall boundary of semi-detached or row housing:

- natural or fibre-cement slates;
- clay tiles;
- concrete tiles;
- self-supporting profiled metal sheeting;
- metal sheeting (e.g., copper, lead or zinc) supported on a plywood, OSB or chipboard deck; and
- mastic asphalt supported on a plywood, OSB or chipboard deck. This implies that asphalt shingles similarly supported would be designated AA for use on any roof.

In the UK, almost all housing uses natural or fibre-cement slates, clay tiles or concrete tiles.

Site preparation and resistance to moisture

Cladding for roofs should have overlapping dry joints, be impervious or weather-resisting, and be backed by a material which directs water or snow coming through the cladding back to the outer face at the eaves (i.e., a drained and vented cavity).

In the UK, all housing has a cavity between the pitched roof cladding and the underlay over the inner structural system.

- The roof cladding is the first line of defence against rain or snow penetration. It is normally accepted that some rain or snow will penetrate all claddings.
- The cavity and underlay is the second line of defence and any rain which penetrates the cladding drains down on the underlay to the eaves and into the gutter. The openings are protected to prevent the ingress of insects.
- For all UK roofs the most common underlay is a fibre-reinforced bitumen membrane called "roofing felt." Low vapour resistance "breather" products are now penetrating the market, especially for roofs with attic rooms.
- Skylight (rooflight) to roof joints and service penetration joints are protected with flashings and or compressible seals.
- Ridges, hips, valleys and verges are sealed with mortar, mastic or lead.

Ventilation

Ventilation methods depend upon the roof pitch and ceiling position.

For roofs with a pitch of 15^0 or more and insulation at flat ceiling level:

- There should be openings at the eaves on two opposite sides of the roof at least equal to a continuous opening of 10 mm wide.

- If a mono-pitch or lean-to roof, the eaves ventilation should be as above and the openings at high level should be at least equal to a continuous opening of 5 mm wide.

For roofs with a pitch of less than 15^0 and those where the ceiling follows the pitch of the roof (any pitch):

- There should be ventilation openings in two opposite sides of the roof at least equal to a continuous opening of 25 mm wide.
- Roofs with a span of 10 m or more or, other than a simple rectangle in plan, may require more ventilation (i.e., 0.6 per cent of the roof area).
- The space between the top of the insulation and the roof deck should be at least 50 mm.
- If a pitched roof with insulation at ceiling level, there should be openings at the ridge at least equal to a continuous opening of 5 mm wide.

In both cases the eaves vents are usually proprietary products which fit into a soffit board or above the fascia board as an over-fascia vent. They incorporate an insect screen. High-level venting can be obtained through special tiles or slates, but ventilated ridge capping is most commonly used.

It is recommended UK practice (but not mandatory) to install a vapour control layer (e.g., 0.12-mm polyethylene) in roofs where the insulation follows the roof pitch as ventilation is considered less reliable with a narrow airway. (In Canada this is mandatory—an air and vapour barrier would be normal in all roofs.)

For room in the roof construction it is now acceptable to vent in a counter-batten space above a low vapour resistance underlay rather than directly above the insulation. This enables fully insulated closed roof panels to be manufactured off-site.

Conservation of fuel and power in dwellings

The relevant part of the Regulation for roofs in housing up to three storeys is *"...(a) limiting the heat loss through the building fabric;..."*

This is done in Approved Document L1 by setting maximum "U-values" for different roof types. The U-values for the compliance with the Elemental Method of AD-L1 are:

Table 5: Roof U values

Exposed Element	U-value	R_{metric}	$R_{imperial}$
Pitched roof with insulation between rafters (insulation on pitch with attic room)	0.20	5.00	28.4
Pitched roof with integral insulation (e.g., structural insulated panel- "SIP" panel)	0.25	4.00	22.7
Pitched roof with insulation between joists (insulation horizontal at ceiling)	0.16	6.25	35.5
Flat roof (pitch less than 10^0)	0.25	4.00	22.7

The actual roof U-value is dependent on the level of thermal bridging caused by the ceiling joists or rafters. Table 6 gives the thickness of insulation for a given U-value based on two layer applications of mineral wool (glass or rock with a thermal conductivity of 0.04 W/mK).

Table 6: Thickness of Mineral Wool for Roof U values

Exposed Element	U-value	Mineral wool (mm)
Pitched roof with insulation between rafters (insulation on pitch with attic room)	0.20	200
Pitched roof with insulation between joists (insulation horizontal at ceiling)	0.16	262
Flat roof (pitch less than 10^0)	0.25	165

These are given as actual thickness, which is not necessarily commercially available. Alternatively, insulation with a lower thermal conductivity will reduce overall thickness or, a combination of low-cost mineral wool between rafters with a rigid insulation over the timber face may be the best option. The range of options is very large.

There is an AD-L1 requirement that the building fabric should be constructed so there are no significant thermal bridges or gaps in insulation within the building elements, at joints and at the edges of elements. AD-L1 also requires that reasonable provision should be made to reduce unwanted air leakage. However, the need for adequate ventilation should be taken into account. Acceptable details are given in the document *Limiting Thermal Bridging and Air Leakage: Robust construction details for dwellings and similar buildings.* Current UK timber frame easily meets these requirements. The roof details from Canada would easily exceed these new standards (it is effectively an air leakage standard of 6 ACH at 50Pa).

Regulation 7

Timber preservative pre-treatment

Preservative pre-treatment of softwood roof lumber is required in certain areas of Surrey, Berkshire and Hampshire south and south-west of London to resist attack by the House Longhorn beetle. This beetle is very localized geographically and can only live in roofs in those areas. This has been omitted from the 1999 AD to Regulation 7 and will be in the revised AD-A due sometime in 2002, but the requirement still applies. The actual geographical areas, which require treatment, are listed in the 1992 edition of the AD to Regulation 7.

Roof structural lumber in other areas is not usually preservative treated, but some clients request this as a "low-cost insurance."

It is almost universal to treat slate and tiling battens. The treatment is always CCA and the battens are sold off the shelf pre-treated.

EXPORTER NOTES: Roofs

- **Canadian exporters should not have any difficulty meeting the Part A roof structure standards, but structural calculations will be needed.**
- **Some trussed rafter nail plate suppliers in Canada are the same as those in the UK, but it is not yet known if the design software can easily be adapted to carry out "UK" truss designs. Negotiations are underway.**
- **NLGA graded lumber and COFI stamped plywood is accepted. Canadian OSB may need testing.**
- **A preliminary consultation with a UK structural engineer is recommended.**
- **It is common as in Canada to use gypsum board as the ceiling lining in housing. This will meet the surface spread of flame requirements in the UK whether the gypsum board is exported or UK or EU product is used. Exporters can use lumber as a ceiling lining as this can be upgraded to Class 1 by surface or impregnation treatment.**
- **Where the attic room is used as a habitable space, the walls and floors need 30- minute fire resistance. The metal nail plates of attic trussed rafters need special protection.**
- **It is assumed that most exporters will not export heavy roof claddings such as tiles or slates. Asphalt shingles are likely to be acceptable in fire spread terms. There may be consumer and lending body resistance to asphalt shingles. If alternative coverings such as wood shingles, thatch or other combustible materials are proposed, specialist advice should be obtained.**
- **Canadian permeable roof underlay membranes will be accepted in the UK. Typical Canadian details for keeping water out will work for the UK.**
- **The concept of ventilating roofs is well known in Canada although the UK rules differ slightly.**
- **For exporters supplying trussed rafters, a contracting partner best addresses the ventilation issues in the UK.**
- **Current Canadian roof details would normally meet the requirement to limit thermal bridges and would typically give a more airtight construction than UK timber roofs. Limiting air leakage may be a marketing advantage.**
- **Exporters building roofs in the House Longhorn areas will need to treat the softwood roof lumber. The preservative treatments in *Exterior Walls* are suitable for these roofs.**

WINDOWS, ROOFLIGHTS AND DOORS

The relevant parts of *The Building Regulations 2000* that define the performance requirements for windows, rooflights and doors for houses up to three storeys are:

- B - Fire safety
- C - Site preparation and resistance to moisture
- F - Ventilation
- L1 - Conservation of fuel and power in dwellings
- M - Access and facilities for disabled people
- N- Glazing
- Regulation 7

Fire safety

Means of warning and escape

In UK houses of more than one storey, bedrooms at upper storeys are provided with an escape window of area at least 0.33 m^2, which is at least 450 mm x 450 mm and with the base of the opening no more than 1,100 mm above the floor. The area and dimensions are a little bigger than the Canadian standard.

Rooms other than kitchens, bathrooms, WC's and utility rooms on the ground floor should exit into a hall leading to a front or back door or have an escape window as above. It is usual for designers to use the "exit into a hall" option.

For three-storey houses in the UK, all the rooms normally exit into a stairwell surrounded by a 30-minute fire resisting wall construction (called a protected stairway) and all the doors onto the stairwell need to be 20-minute "fire doorsets." The term doorset means the door leaf, the frames, the handles and hinges. Most doors onto the protected stairwell are actually 30-minute doors although only 20-minute door is required.

Interior doors between a house and an attached garage are required to be 30-minute doorsets.

Internal fire spread (linings)

The linings of walls and ceilings in houses up to three storeys generally need to have a surface classification of Class 1 Surface Spread of Flame including walls in garages and circulation spaces.

Doors (including glazing in doors) and door frames and window frames are not part of the wall so do not need to be Class 1. Window glazing is part of a wall but is assumed to meet Class 1.

Rooflight frames are not part of the ceiling so do not need to be Class 1. Rooflight glazing is part of a ceiling but is assumed to meet Class 1.

External fire spread

The amount of glazing and wood cladding can be restricted by the rules for allowable unprotected areas in relation to distance of the houses from boundaries. An unprotected area is a door or window or a wall with combustible cladding such as wood. UK designers would check this according to the rules in Table 1 in *Appendix 1.*.

Site preparation and resistance to moisture

Window or door to wall openings and rooflight to roof openings are normally protected with flashings and or compressible seals. The flashings are commonly 0.5 mm polyethylene fixed to pressure relief grooves in the joinery and dressed into the wall or roof to direct water back to the outer side of the cavity. Pre-compressed seals are sometimes fitted at the back face of the joinery as an air and secondary water seal. More recently, pre-compressed seals are being used as the primary weather seal fitted at the front face of the joinery.

Ventilation

In the UK, windows are essential to the provision of room ventilation in housing. Ventilation provisions are given in Table 3 in *Appendix 1.* The provisions involve a combination of rapid ventilation (typically an openable window with some part of the ventilation at 1.75 m above the floor) and background ventilation (typically a slot controllable ventilator at the head of windows). The slot ventilator is not essential in windows and ventilation can be provided in other ways.

It is also common to leave a space below interior doors (a door "undercut") so that air can flow to the relevant exhaust point.

Full mechanical ventilation is acceptable in UK housing, although rare. When full ventilation is present, the openable window with slot control vents may still be specified. This is done in the belief that occupants may still wish to control comfort and air quality manually using the slot vents or the windows.

Conservation of fuel and power in dwellings

The relevant part of the Regulation for windows, rooflights and doors in housing up to three storeys is *"...(a) limiting the heat loss through the building fabric; ..."*

This is done in Approved Document L1 by setting a maximum combined U-value for windows, rooflights and doors. The U-value for the compliance with the Elemental Method of AD-L1 is 2.0W/m^{2}K (R_{metric} =0.45m^{2}K/W; $R_{imperial}$ =2.6) if the frames are metal or, 2.2W/m^{2}K (R_{metric} =0.5m^{2}K/W; $R_{imperial}$ =2.8) if the frames are wood or PVCu.

Wood-framed windows with low-emissivity double glazing and an air gap of 16 mm will give a U-value of 2.0W/m^{2}K. Triple glazing will also meet 2.0.

A 45-mm thick solid hardwood door will also have a U-value of 2.0W/m^{2}K.

For the Elemental U-values given above the total area of windows, doors and rooflights should not exceed 25 per cent of the total floor area. The window area can be varied under the Target U-value or Carbon Index methods. These two calculation methods offer the designer more flexibility to take into account solar and renewable energy and innovative building fabrics and equipment. Check AD-L1 for more detail.

There is also an AD-L1 requirement that the building fabric should be constructed so there are no significant thermal bridges or gaps in insulation within the building elements, at joints and at the edges of elements. AD-L1 also requires that reasonable provision should be made to reduce unwanted air leakage. However, the need for adequate room ventilation should be taken into account. Acceptable details are given in the document *Limiting Thermal Bridging and Air Leakage: Robust construction details for dwellings and similar buildings*. Current UK windows and doors and the joint details can meet these requirements. The window and door details from Canada are likely to easily exceed these new standards (it is effectively an air leakage standard of 6 ACH at 50Pa).

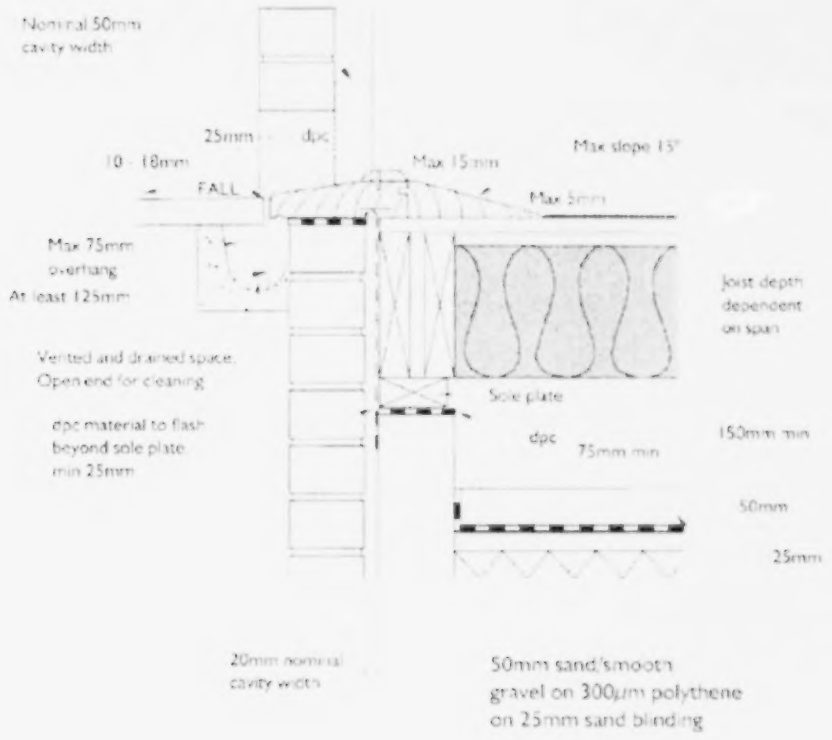
Access and facilities for disabled people

Approved Document M requires that at least the principal entrance to all new housing should be accessible to disabled people. This means that the threshold should be level to allow entry for wheelchair users.

In social housing all entrances are accessible; typically at the front and back and, also at patio or French door locations. This is also being considered in some private sector developments.

A typical accessible threshold, showing the special door detail at the base, for a UK timber suspended ground floor is shown in Figure 6.

Figure 6: Level Threshold for a Timber Suspended Ground Floor



Glazing

Safety in relation to impact, opening and cleaning

There are certain locations in UK housing which are considered "critical" in terms of safety for glazing:

- up to 800 mm above floor level in windows; and
- up to 1,500 mm in doors and door side panels.

Designers take this into account and glazing in these critical locations can be designed to:

- break safely;
- be robust or in small panes; or
- be permanently protected.

Compliance with these safety options is described in *Appendix 1*. In doors and windows in UK housing, the "break safely" option is by far the most common in the critical locations. Safe breakage is defined in BS 6206, which simplistically says that the broken glass should be in small pieces without sharp edges. To meet this requirement laminated glass is normally specified in the critical locations.

Regulation 7

Preservative pre-treatment for windows

The Building Regulations are not specific about preservative pre-treatment for wood windows and rooflights but many local authorities adopt the housing warranty body guidance as part of Regulation 7.

If the joinery frame wood species is naturally durable and all sapwood is excluded, then no preservative treatment would be required. It is common to use non-durable softwoods for joinery frames, mostly pine or spruce. These joinery frames are required by warranty bodies to be preservative pre-treated.

The treatment process may be copper-chrome-arsenic (CCA) to BS 4072 or double vacuum organic solvent (OS) to BS 5707: Part 1.

CCA is never used and the most common treatment is the OS process.

EXPORTER NOTES: Windows, Rooflights and Doors

- **An escape window is required in storeys above ground in UK houses. In certain cases they may also be required at the ground floor. Exporters should not have difficulty with this requirement.**

- **Exporters can assume that Canadian windows and doors will not require surface spread of flame treatment.**

- **Exporters who take on design responsibility will need to check the unprotected area rules in Table 1 in** *Appendix 1*.

- **UK weathersealing details for windows, doors and rooflights at the wall and roof openings are similar to those in use in Canada**

- **Window exporters should consider the current UK preference for opening windows and/or vents for ventilation.**

- **The benefits of mechanical ventilation systems are not yet commonly recognized in the UK. Any system would need to come with an occupant (and client) education programme.**

- **Canadian windows, doors and detailing may offer marketing advantages and opportunities for exporters. It is assumed that Canadian windows will easily meet UK requirements.**

- **Canadian doors with metal linings and an insulated core will have insulation advantages.**

- **Standard Canadian joinery details would typically give a more airtight construction than those used in the UK. Exporters should provide the special door threshold, which may be different than most Canadian thresholds.**

- **UK glazing could be applied to export frames. Exporters of windows and doors may need to specify laminated glass in certain critical locations. Other methods of providing safe glazing may be demonstrated.**

- **Exporters should assume that external wood joinery members for windows and rooflights will require preservative treatment.**

SERVICES DESIGN AND INSTALLATION

The relevant Parts of *The Building Regulations 2000* that define the performance requirements for services design and installation (including ventilation) for houses up to three storeys are:

- A - Structure
- B - Fire safety
- E - Resistance to the passage of sound
- F - Ventilation
- L1 - Conservation of fuel and power in dwellings

Structure

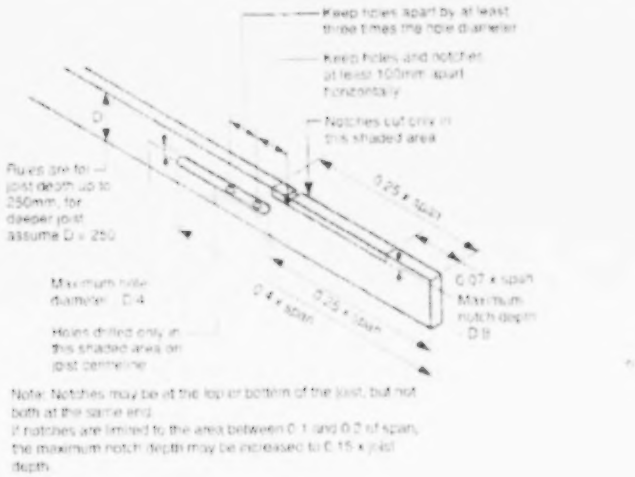
It is common in UK timber frame to install first fix services (i.e., the basic pipes and wiring but not the final fixtures or fittings) such as plumbing, electrical, heating and telecommunication services after the house is weathertight. These services are usually installed in the framed stud, joist and rafter cavities.

It is essential that the notching and drilling of studs and joists does not impair the structural stability.

The rules for notching and drilling floor joists are shown in Figure 7.

*Notches may be at the top or bottom of joists but not both at the same end. If notches are limited to the area between 0.1 and 0.2 of span, the maximum notch depth may be increased to 0.15xjoist depth.

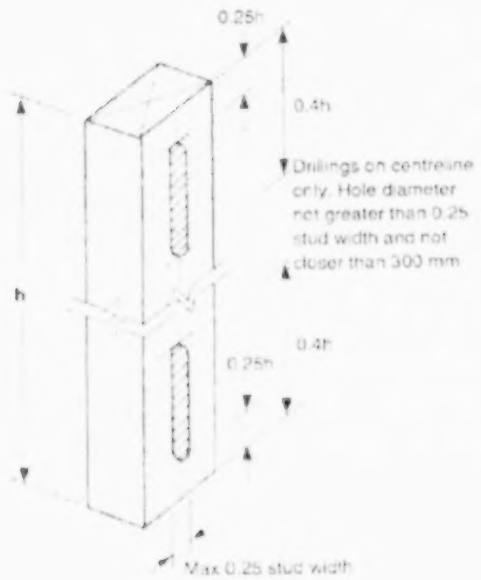
Figure 7: Notching and Drilling of Floor Joists


Keep holes apart by at least three times the hole diameter
Keep holes and notches at least 100mm apart horizontally
Notches cut only in this shaded area
D
Flues are for joist depth up to 250mm, for deeper joist assume D = 250
0.25 x span
0.07 x span
Maximum notch depth D/3
Maximum hole diameter D/4
0.4 x span
0.25 x span
Holes drilled only in this shaded area on joist centreline
Note: Notches may be at the top or bottom of the joist, but not both at the same end.
If notches are limited to the area between 0.1 and 0.2 of span, the maximum notch depth may be increased to 0.15 x joist depth

The rules for drilling studs are shown in Figure 8.

*Studs should not be notched unless there is a calculation to show it is acceptable

Figure 8: Drilling of Studs



These rule of thumb limits can be exceeded but calculations to BS 5268: Part 2 by an approved structural engineer will be required.

Roof structural members should not be notched drilled or otherwise cut away unless calculations to BS 5268: Part 2 by an approved structural engineer are carried out.

Fire safety

Internal fire spread (structure)

If a fire separating element is to be effective, then each joint or imperfection for services penetration needs to be protected by sealing or fire stopping. Fire stopping is installed around openings where services penetrate an exterior or interior loadbearing wall, a party wall, an intermediate floor or parts of attic room walls which are fire resisting. A fire stop has the same fire resistance as the element in which it is located.

Proprietary fire stops in the form of "intumescent collars" (these swell when heated and crush and close off the pipe) are often used on large pipes or ducts where they pass through floors in a two- or three-storey house. Other common fire stops used around services penetrations through walls (including party walls) or floors include:

- gypsum plaster
- mineral wool (glass or rock)
- intumescent mastics.

All of these are in common use and the choice depends on the type of service penetration.

It is always considered good practice to avoid services in party walls to avoid compromising the fire resistance. This is not always practical and, in narrow fronted row housing, for example, would be almost impossible.

If services are essential in a party wall, then fire resistance continuity is necessary. This is normally achieved by forming a duct or space set onto the wall which is lined on all sides with the same 30-mm plasterboard thickness as the adjacent wall. Since a duct will narrow the party wall cavity, it is preferable if service ducts are not located back to back.

Resistance to the passage of sound

It is always considered good practice to avoid services in party walls to avoid compromising the sound insulation. This is not always practical and, in narrow fronted row housing, for example, would be almost impossible.

If services are essential in a party wall then the acoustic performance continuity is necessary. This is normally achieved by forming a duct or space set onto the wall which is lined on all sides with the same
30-mm plasterboard thickness as the adjacent wall. Since a duct will narrow the party wall cavity it is preferable if service ducts are not located back to back.

Ventilation

Mechanical systems for ventilation are rare in UK housing. **This form of providing fresh air is often considered to be unhealthy by tenants and homeowners.** It is also considered to be

expensive to run and maintain, and perceived to be noisy. The UK consumer will need to be informed that these perceptions are not the universal truth.

Mechanical ventilation is acceptable in the UK and there is not a requirement that slot ventilators are also needed in windows. The mechanical system is an alternative to these and the other extract and openable windows described in *Appendix 1.*

If mechanical ventilation systems are provided, they would generally need to be in accordance with or equivalent to the requirements of:

- BS 5720:1979 - Code of practice for mechanical ventilation and air-conditioning in buildings, or
- BRE Digest 398 - Continuous mechanical ventilation in dwellings: design, installation and operation.

Typically, "equivalent" would need to be established by some form of independent approval if the requirements of the above documents could not be met (see *Section 5: An Overview of UK Housing warranty Programmes*).

Conservation of fuel and power in dwellings

The relevant part of the Regulation for services design and installation in housing up to three storeys is...

"(a) limiting the heat loss:

(ii) from hot water pipes and hot air ducts used for space heating;

(iii) from hot water vessels;

(b) providing space heating and hot water systems which are energy-efficient;

(c) providing lighting systems with appropriate lamps and sufficient controls so that energy can be used efficiently;

(d) providing sufficient information with the heating and hot water services so that building occupiers can operate and maintain the services in such a manner as to use no more energy than is reasonable in the circumstances."

There is detailed guidance in AD-L1 on with alternative ways of limiting heat loss from pipes, ducts and storage vessels, and the controls for heating and lighting services. *Getting Started!* assumes that Canadian exporters will not be exporting conventional heating systems or lighting to comply with Part L1. The key AD-L1 standards and approach to meeting the functional performance requirements for services provision are given in *Appendix 1.* Exporters involved in more complete design and supply of services should study AD-L1 for more detail.

While not part of the AD-L1 guidance there are three safety issues related to electrical installation.

1. All electrical services should meet the requirements of BS 7671 *Requirements for electrical installations.*
2. Where electrical cables are enclosed by or adjacent to insulation they may need to be de-rated to avoid overheating.
3. PVC sheathed cable should not be in contact with expanded polystyrene as the cable plasticiser can leach to make the sheathing brittle.

EXPORTER NOTES: Windows, Rooflights and Doors

- **Exporters should ensure that services installers have the approved rules for notching and drilling for their particular system.**
- **Exporters should not assume that UK plumbers and electricians know the UK rules for notching and drilling in studs and joists.**
- **Although exporters will not normally be involved in site work, a working knowledge is important for inspections.**
- **If services were to be installed in the Canadian factory, detailed knowledge of fire safety would be needed.**
- **Ducts for services may need to be provided in party walls.**
- **Before mechanical ventilation systems are exported to the UK. a marketing exercise in terms of client and consumer acceptance is recommended.**
- **If mechanical systems are used, exporters should check compliance with BS 5720, BRE Digest 398, or investigate an independent approval.**
- **A system using mechanical ventilation would need to come with an occupant (and client) education programme as the benefits of such an approach are not yet commonly recognized in the UK.**
- **UK timber frame design is not familiar with incorporating the size of ducts used for mechanical ventilation. Clients need to be informed of differences. Pre-planning is crucial.**
- **There are detailed rules for hot-water systems and lighting which some exporters may need to know (see AD-L1).**
- **Be aware of the electrical installation safety issues.**

SECTION 4: PRODUCT AND SYSTEM APPROVALS AND CERTIFICATION PROCEDURES

PRE-EXPORT APPROVALS PROCEDURES

The route to approvals and certification of Canadian export products into the UK seems to be very complex. It is further complicated perhaps by competing commercial bodies in the testing, assessment and certification markets that assure exporters they need to fulfill certain requirements and only they, the particular UK approval body, can advise and help the importer to meet these requirements.

The route can be complex but *GETTING STARTED!* aims to simplify this.

There are no real secrets or new innovative concepts associated with the Canadian "2 x 4" platform-frame approach to building houses up to three storeys; detached, semi-detached or row houses. There are some materials and conceptual differences, all as detailed in *Section 3: Meeting the Building Regulations 2000 Performance Requirements*, but the system is fundamentally the same in the UK as it is in Canada. All difficulties of approval and certification tend to result from a product or system that is unknown or there is no recognized standard or method for assessment. This is not the case for wood-frame housing from Canada as an overall system or in terms of the constituent parts. (This is specific to mainstream "2 x 4" platform frame and not to innovative systems in UK terms such as structural insulated (SIP's) panels or log homes.) This lack of difference is fundamental.

The pre-export approval and certification options assume that in the short term, Canadian approvals and certification will not be accepted in the UK and Europe (collaborative work by Canada Mortgage and Housing Corporation may well change this assumption).

British, European or ISO Standards Assessment

If the export is a product or component which can be associated with a BS, a BS EN or a BS EN ISO existing standard, then a test programme may be carried out by a United Kingdom Accreditation Service (UKAS) approved test facility or laboratory with a report issued to demonstrate acceptability. (BS is the prefix for all standards of the British Standards Institute; EN designates Europe; ISO is the prefix for all standards of the International Standards Organization.)

Certification Approvals

If the building system, product or component is a "one-off" or not known to the UK or Europe, then some form of independent assessment and subsequent certification is almost certainly needed. This assessment and certification can be done by any European Technical Approval (ETA) body and there are three in the UK. These are the British Board of Agrément (BBA), BM TRADA Certification (BM TRADA Certification Limited) and BRE Certification (Building Research Establishment Ltd.). For ETA purposes, each body has a scope of product or component types for which they are accredited to certify. Exporters should check these scopes to ascertain which certifier

can do the work (taking into account the certification costs of course). The Canadian Construction Materials Centre (CCMC) has a liaison agreement with the BBA. Importers should be aware that this approval route tends to have high costs relative to other routes and can take one to two years. However, for certain unique products or systems there may not be an alternative.

Full certification of a building system, a product or a component is a certain route to speedy acceptance to all markets and to easy approvals. Some companies opt for this route not because they have to for technical reasons, but because it helps with smooth acceptance and can be a marketing tool. It is common for new UK products to be certified because of peer pressure and a belief that the product will not be competitive if it is not certified. Exporters should be very clear as to the technical need for certification. If it is not needed for **technical reasons**, then exporters can make a decision on **marketing grounds**.

Assessment by Independent Consultants

If the imported system is conventional timber frame, a check against UK good practice may be sufficient. For example, a check can be made against the details in the Timber Research and Development Association (TRADA) book, *Timber Frame Construction*, which is usually accepted for building regulations.

Some material checks may be needed in terms of a BS, a BS EN or a BS EN ISO. The acceptability of Canadian OSB may be an example. Tests to BS EN 300 can be carried out to assess a Canadian board for compliance as an OSB-3. The OSB products currently in use in the UK are all certificated and there is peer pressure on exporters to have any new board certificated. **It is not necessary to demonstrate compliance and should only be done if perceived necessary for marketing. If it complies with BS EN 300 that is all that is needed at a technical performance level.**

Structural calculations for the housing system will be required and at least a check by a UK engineer would be advised. This route will require submission to each local authority for building regulation approval for each housing scheme proposed.

LANTAC Approval

There is an alternative to full ETA type certification for housing systems or parts of a system, which in the UK offers all of the same benefits, but at a lower cost and in a shorter assessment time. This is called a Local Authority National Type Approval Confederation (LANTAC) Approval. LANTAC is the only organisation in the UK, which specializes in developing fast track routes through the regulatory procedures for standard buildings, modular buildings or building systems. All local authorities throughout England and Wales are members of LANTAC. **There are two kinds of** Building Regulation Approvals issued under LANTAC, generically described as either *System Approval* or *Type Approval*.

System Approval

System Approval is suitable for building systems, which are capable of producing a variety of buildings using standard components and construction details.

Type Approval

Type Approval is suitable for both complete building designs and for standard building modules, which are repeated in different areas. Permanent variations to such designs can be included with a type approval.

CE Marking

Certain products and systems may be able to be labelled with a CE mark (Conformité Européen) based on a harmonized European Community standard. There is currently an ETA Guideline for timber frame "kits" which may in due course lead to a compulsory CE marking. Such a mark implies that the product or system will automatically be accepted in all EU markets. The CE mark is not a quality mark but merely says the product meets a common standard. The status of CE marking in the UK is not yet clear as the UK government has not accepted the marking. At the moment CE marking is not considered important in terms of marketing or approvals for Canadian building products for import.

SECTION 5: AN OVERVIEW OF UK HOUSING WARRANTY PROGRAMMES

There are two UK providers of house warranties. (A third warranty provider, Housing Association Property Mutual has ceased taking any new business.) These providers are:

- The National House-Building Council (NHBC)
- Zurich Insurance Building Guarantees

NHBC

NHBC is the market leader and has been active in the warranty sector for more than 60 years. It accounts for about 85 per cent of the new home building warranty market and has over 18,000 registered housebuilder members. The majority of its market share is in private sector housebuilding, with a smaller percentage of its turnover in the public and social housing sector.

Housebuilders are assessed and graded according to a detailed technical and financial vetting system. Once accepted into membership, they must comply with the NHBC construction and technical standards, which are very detailed.

A range of warranty and insurance services is available at varying levels of cost premium. The standard product coverage known as the "NHBC Buildmark" runs for 10 years.

The coverage protects buyers of new homes against specified defects resulting from the builder not complying with NHBC Standards. The specified defects are called "major structural defects" which are not always easy to define. Social housing developments can secure 12-year coverage (Buildmark Plus) for an additional premium.

The builder is responsible for all defects in the first two years. After that, the responsibility reverts to NHBC.

NHBC maintains a close relationship with its housebuilder members and has probably done more than any other organization to raise standards throughout the UK building industry.

The NHBC now also offers Building Regulations approval assessment as part of its services to housebuilders. When this option is chosen, builders do not have to deal with the building control departments of individual local authorities.

ZURICH INSURANCE BUILDING GUARANTEE

Zurich Insurance Building Guarantee is part of the worldwide Zurich Financial Services Group. Having entered the market in the early 1990s, it is now widely recognized in the UK as a leading developer of latent defects insurance and services for the new home warranty market. This innovative approach has resulted in Building Guarantee taking a significant share of the UK market—a share that continues to grow in both speculative and social housebuilding sectors.

The Zurich '10' warranty policy provides coverage for 10 years from either the effective date of the final inspection or exchange of contracts if later. This is important since it means that even where a property is not sold until after its final inspection, it will still carry the benefit of full 10-year coverage. The policy provides for a two-year insurance backed warranty by the developer; Building Guarantee steps in if the housebuilder fails to meet their obligations or goes into liquidation; and a further eight years of structural latent defect coverage. Zurich also offers the option to take up additional coverage to extend the basic policy provision to both the housebuilder and/or the new homeowner. At the end of the 10-year term, policyholders can apply for coverage to be extended for a further five years.

Building Guarantee produces their own technical standards and employs their own surveyors. They assess each development on its own merits, considering the complexity of the site, its environment, the type of construction being adopted and the capabilities and expertise of the builder/developer. Zurich's surveyors undertake key stage inspections of projects under construction. It is a key risk management process, and a failure to meet requirements can result in insurance coverage not being given.

Building Guarantee does not as yet offer a building regulation approval service. They work with and alongside other approved inspector bodies. In particular, they have a strong working relationship with local authority building control. This is partly as a result of their historical links as providers of insurance to municipal authorities and also because of the restricted number of bodies providing building control to housebuilders in the UK. These restrictions are now being removed and the number of approved building control authorities for the housing market is expected to increase over the next few years.

Zurich Insurance Building Guarantee is seen in the UK marketplace as the NHBC's only significant competitor. It has now recognized the Canadian Super E® technology and has written a new chapter for this in the *Building Guarantees Technical Manual*.

SECTION 6: REFERENCES AND FURTHER INFORMATION

Building Regulations

The Building Regulations 2000
The actual Regulations and all of the Approved Documents may be downloaded from
www.safety.odpm.gov.uk/bregs

The Building Standards (Scotland) Regulations 1990 as amended
The actual Regulations and the Technical Standards, all in one document, may be downloaded from
www.scotland.gov.uk/build_regs

The Building Regulations (Northern Ireland) 2000
The actual Regulations may be downloaded from
www.buildingcontrol.org/bcni/legislation/regulations.asp
The Technical Booklets can be purchased from The Stationery Office or on-line at
www.hmso.gov.uk

Codes and Standards

British Standards Institution
389 Chiswick High Road
London W4 4AL
(T) +44 (0)208 996 9001
(F) +44 (0)208 996 7001
www.bsi-global.com

Warranty Authorities

National House-Building Council
Buildmark House
Chiltern Avenue
Amersham
Bucks HP6 5AP
(T) +44 (0)1494 434477
(F) +44 (0)1494 728521
www.nhbc.org.uk

Zurich Insurance Building Guarantees
6 Southwood Crescent
Farnborough
Hampshire GU14 0NJ
(T) +44 (0)1252 522000
(F) +44 (0)1252 372989

Certification and Approvals

BM TRADA Certification
Hughenden Valley
High Wycombe
Bucks HP14 4NR
(T) +44 (0)1494 569700
(F) +44 (0)1494 565487
www.bmtrada.com

British Board of Agrément
PO Box 195
Bucknalls Lane
Garston
Herts WD25 9BA
(T) +44 (0)1923 665300
(F) +44 (0)1923 665301
www.bbacerts.co.uk

BRE Certification
Garston
Herts WD7 7JR
(T) +44 (0)1923 664577
(F) +44 (0)1923 664335
www.brecertification.co.uk

LANTAC
LABC Services
137 Lupus Street
London SW1V 3HE
(T) +44 (0)207 641 8740
(F) +44 (0)207 641 8739
www.labc-services.co.uk

Canada Export Information

Canadian Construction Materials Centre (CCMC)
National Research Council
Ottawa, Ontario K1A 0R6
Tel: (613) 993-6189
Fax: (613) 952-0268
www.nrc.ca/irc/ccmc

Canadian High Commission
1 Grosvenor Square
London W1K 4AB
Tel: +44 207 258 6664
Fax; +44 207 258 6384
www.infoexport.ga.ca/uk

Canada Mortgage and Housing Corporation (CMHC)
CMHC International
700 Montreal Road
Ottawa, Ontario, Canada
K1A 0P7
Tel: (613) 748-4893
Fax: (613) 748-2302
www.cmhc.ca

Natural Resources Canada (NRCan)
CANMET Energy Technology Centre
580 Booth Street, 13th floor
Ottawa, Ontario K1A 0E4
Tel: (613) 943-2260
Fax: (613) 996-9909
www.nrcan.gc.ca

Super E® Program
Tel.: (877) 606-0663
www.super-e.com

Team Canada Inc.
Tel.: (888) 811-1119
www.exportsource.gc.ca

APPENDIX 1: A SUMMARY OF THE APPROVED DOCUMENTS TO THE BUILDING REGULATIONS 2000 RELEVANT TO EXPORTERS FOR HOUSING UP TO THREE STOREYS

For each part of **The Building Regulations 2000** relevant to housing up to three storeys, the simple functional performance requirement is given with the associated Approved Document (AD). This is followed by a description from the AD of the minimum standards and the approach to demonstrate compliance with these performance requirements.

Approved Document A - Structure (1992 Edition)

The functional performance requirement is:

A1 Loading
The building should be built so that the combined dead, imposed and wind loads are sustained and transmitted to the ground safely and without affecting the stability of another building.

The AD-A standards and approach to meeting the functional performance requirement of *A1 Loading* are:

- The structural design of all timber frame exterior walls should be in accordance with BS 5268: Part 2 and BS 5268: Part 6: Section 6.1. Part 2 is used for the design of studs, rails and lintels to carry vertical loads. Section 6.1 is used for the calculation of resistance to horizontal wind loads (or racking stability).

- The structural design of floors should be in accordance with BS 5268: Part 2.

- The structural design of trussed rafter roofs including bracing should be in accordance with BS 5268: Part 3. The design of all other roofs should be in accordance with BS 5268: Part 2.

- As an alternative to BS 5268, Eurocode 5 can be used for all structural timber design. At present it is uncommon to use this "limit state" design Code but some time in the next eight to ten years it will supersede BS 5268.

- Most important to exporters, the authority responsible for assessing compliance with *The Building Regulations 2000*, Part A will normally require full structural calculations which are required to be certified by an approved structural engineer.

PROPOSALS FOR AMENDING PART A—Structure

The timber floor and roof span tables will be omitted from the next AD-A. TRADA have confirmed that they will be producing a new updated set of span tables.

It is expected that new information associated with disproportionate collapse will be included. This only applies to buildings of five storeys or more and is outside the scope of this guide.

Approved Document B - Fire safety (2000 Edition)

The first functional performance requirement is:

B1 Means of warning and escape
Buildings should be designed to give early warning of a fire and allow a safe means of escape to outside in the event of a fire.

There is very detailed guidance in this Part of AD-B. It is principally associated with house design in terms of layout planning rather than construction details. Only the key basic AD-B standards and approach to meeting the functional performance requirement of *B1 Means of warning and escape* are given here and exporters involved in architectural design may need to check AD-B1 for more detail:

- All houses require an automatic fire detection and alarm system or a smoke alarm system. There are special provisions for "large houses" (i.e., those with any storey more than 200 m^2).

- Bedrooms at upper storeys should have an escape window of area at least 0.33 m^2, which is at least 450 mm x 450 mm and with the base of the opening no more than 1100 mm above the floor.

- Rooms other than kitchens, bathrooms, WC's and utility rooms on the ground floor should exit into a hall leading to a front or back door, or have an escape window as above.

- For three-storey houses all the rooms should exit into a stairwell surrounded by a 30-minute fire resisting wall construction (called a protected stairway) and all the doors onto the stairwell should be 20-minute fire resistance "fire doorsets". For two-storey houses, the stairway does not have to be protected and the doors to the stair enclosure do not have to be fire doors—in fact there does not have to be a stair enclosure. No fire doors are needed in single storey houses.

- Doors from a house to an integral garage should be 30-minute fire resistance "fire doorsets."

The second functional performance requirement is:

B2 Internal fire spread (linings)
To inhibit the spread of fire within a building, the internal linings of walls and ceilings should resist the spread of fire over their surfaces and, if they do ignite, have a rate of heat release which is reasonable in the circumstances.

The AD-B standards and approach to meeting the functional performance requirement of *B2 Internal fire spread (linings)* are:

- The linings to all walls and ceilings in housing should have a surface spread of flame classification of Class 1 except for rooms less than 4 m^2 which can have a Class 3 surface.

- For walls, up to 50 per cent of the wall area, or 20 m^2 (whichever is the smaller) of the surface may be Class 3. Joinery trim items such as doors, frames, architraves and skirtings are not included and can have any Class surface.

- For ceilings, trap doors and frames, rooflight frames, cover moulds and exposed beams or rafters are not part of the ceiling and do not need to be Class 1.

- Garages less than 40 m^2 can have a Class 3 surface.

Surface spread of flame is essentially a classification of a material in terms of the speed that a flame will move across the material surface in the standard test. Non-combustible materials have the higher classifications of 1 or 0. It is not the same as fire resistance and relates to limiting the contribution of the lining to the development of a fire.

The B3 functional performance requirements are:

B3 Internal fire spread (structure)
(1) A building should be designed and constructed so that, in the event of a fire, its stability will be maintained for a reasonable period.
(2) A wall between two buildings (e.g., between semi-detached or terraced housing) should be designed and constructed to adequately resist the spread of fire between the buildings.
(3) To inhibit the spread of fire in a building it should be sub-divided with fire-resisting construction depending on the size and use of the building.
(4) A building should be designed and constructed so the unseen spread of fire and smoke in concealed spaces (cavities) is inhibited.

The AD-B standards and approaches to meeting the functional performance requirements of *B3 Internal fire spread (structure)* are:

- Loadbearing elements of structure, construction elements which separate one house from another and openings within these elements require fire resistance.

- The fire resistance of a construction element is a measure of its ability to withstand the effects of fire in one or more ways:
  - ***Loadbearing capacity***: resistance to collapse (i.e., the ability to maintain loadbearing capacity),
  - ***Integrity***: resistance to fire penetration through the element (i.e., the ability to maintain the integrity of the element),
  - ***Insulation***: resistance to the transfer of excessive heat (i.e., the ability to provide insulation from high temperatures).

- The fire resistance requirements for houses up to three storeys, are as follows (the method of exposure is shown in brackets):

Table 1: Fire resistance periods for housing up to three storeys

Intermediate floors [from underside]
- Loadbearing capacity- 30 minutes
- Integrity- 30 minutes
- Insulation- 30 minutes

Roofs, only if it forms part of a floor e.g., in an attic trussed rafter or, if the roof is essential to the stability of a fire resisting external wall [from underside]
- Loadbearing capacity- 30 minutes
- Integrity- 30 minutes
- Insulation- 30 minutes

Exterior walls more than 1 m from the boundary [from inside]
- Loadbearing capacity- 30 minutes
- Integrity- 30 minutes
- Insulation- 30 minutes

Exterior walls less than 1 m from the boundary [from each side separately]
- Loadbearing capacity- 30 minutes
- Integrity- 30 minutes
- Insulation- 30 minutes

Internal loadbearing walls [from each side separately]
- Loadbearing capacity- 30 minutes
- Integrity- n.a.
- Insulation- n.a.

Compartment walls i.e., party walls between attached houses [from each side separately]
- Loadbearing capacity- 60 minutes
- Integrity- 60 minutes
- Insulation- 60 minutes

Wall separating an attached or integral garage from a house [from garage side]
- Loadbearing capacity- 30 minutes
- Integrity- 30 minutes
- Insulation- 30 minutes

- Cavity barriers are installed in the cavities between the outside of the timber frame exterior wall and the cladding to restrict the spread of smoke and flame in the cavity. A cavity barrier has a 30-minute fire resistance (integrity and insulation measured from each side separately). For housing up to three stories the requirements for cavity barriers are:
  - horizontal at eaves and at the ceiling line of gables (or at the verge line);
  - vertical at the party walls;

- around all openings (the window or door frame can also be the cavity barrier if it can be shown to have 30-minutes fire resistance.

- If a fire separating element is to be effective then each joint, or imperfection of fit, or door opening, or services penetration, needs to be protected by sealing or fire stopping. Fire stopping is required at the edge of elements i.e., up the wall and over the roof for party walls, and around openings where services penetrate a fire separating element. A fire stop has the same fire resistance as the element in which it is located.

The B4 functional performance requirements are:

B4 External fire spread
(1) The external walls of a building should adequately resist the spread of fire over the walls from one building to another.
(2) The roof of a building should adequately resist the spread of fire over the roof from one building to another.

The AD-B standards and approaches to meeting the functional performance requirements of *B4 External fire spread* are:

- If the house is more than one meter from the boundary there are no restrictions on the type of wall cladding in terms of combustibility or surface spread of flame classification.

- If the detached house is closer than one meter to the boundary or is a semi-detached or terraced house there is a requirement for a Class 0 surface spread of flame to the external surface. This requirement applies only to the part of the surface in the one meter zone on either side of the boundary (for semi-detached and terrace houses the boundary is normally the centreline of the party wall).

- Each elevation of a house up to three storeys may only have a certain amount of unprotected area on that elevation relative to the distance from the boundary. An unprotected area is a door or window or a wall with combustible cladding such as timber. Only half of the wood cladding on the particular elevation needs to be counted. Any part of the wood cladding which is treated to give Class 0 surface spread of flame is not included as unprotected area. These unprotected areas are given in *Table 2 below*.

Table 2: Permitted unprotected areas in housing

Minimum distance between house elevation and relevant boundary (m)	Maximum total area of unprotected area (m^2)
1	5.6
2	12
3	18
4	24
5	30
6	No limit

- The type of roof covering allowed is related to the surface spread of flame classification and to the distance from the boundary. Roof coverings designated AA, AB or AC (e.g., slates, clay or concrete tiles and asphalt or asphalt shingles on a timber board deck) will be acceptable for any boundary distance.

PROPOSALS FOR AMENDING PART B FIRE SAFETY—European Supplement

There is a draft amendment which closed for comment on February 2002, to consider the new European Standards associated with fire safety.

It deals with new methods for testing constructions for fire resistance. While the test methods will be different, it is not expected that any particular construction that has previously been acceptable will be found to be unacceptable. Conventional timber frame in the UK and, as is common in Canada, is expected to meet any changing standards.

The terminology and test procedures associated with reaction to fire are also expected to change—the principal characteristic of this is currently referred to as surface spread of flame. Again, no major changes are expected for timber frame which is plasterboard lined. It is not yet certain as to whether wood internal lining will be more difficult to justify.

Approved Document C - Site preparation and resistance to moisture (1992 Edition)

The first functional performance requirement is:

C2 Dangerous and offensive substances
Precautions are needed to avoid danger to health and safety caused by substances found on or in the ground to be covered by the building.

The AD-C standards and approaches to meeting the functional performance requirement of *C2 Dangerous and offensive substances* are:

- There are a number of areas of the UK where radon gas occurs and in these areas precautions are needed to prevent radon ingress into buildings. The areas are listed in the BRE Report, BR 211.

- Increasingly UK building is on filled or previously used industrial sites (called brownfield sites) where the presence of methane and/or other contaminants may be encountered. In certain cases these contaminants may need to be removed or sealed into the site.

The second functional performance requirement is:

C4 Resistance to weather and ground moisture
The walls, floor and roof of a building shall adequately resist the passage of moisture to the inside of the building.

The AD-C standards and approaches to meeting the functional performance requirements of *C4 Resistance to weather and ground moisture* are:

- Floors should be protected from ground moisture by the use of damp proof membranes between the floor and the ground, and if the floor is suspended, by ventilating the void between the floor and the ground.

- Walls should be protected from ground moisture by the use of damp proof courses at least 150 mm above ground level.

- Cladding for external walls and roofs should have over-lapping dry joints, be impervious or weather-resisting, and be backed by a material which directs water or snow coming through the cladding back to the outer face (i.e., a drained and vented cavity).

Approved Document E - Resistance to the passage of sound (1992 Edition)

The functional performance requirement is:

E1 Airborne sound (walls)
A wall which separates a dwelling from another dwelling or another building; or which separates a dwelling from a part of the same building which is not part of the dwelling (e.g., a lobby) shall have reasonable resistance to the passage of airborne sound.

The AD-E standards and approaches to meeting the functional performance requirement of *E1 Airborne sound (walls)* are:

- A prescriptive two-leaf timber frame wall (wall Type 4A) is shown in AD-E as deemed to meet the requirement.

- There is an implication that a party wall should have an airborne sound insulation in the form of a single value "weighted standardized level difference" ($D_{nT,w}$) in decibels of 53dB. This is a mean value over four tests with an individual minimum value of 49dB. Alternatives to the wall Type 4A can demonstrate compliance by test.

PROPOSALS FOR AMENDING PART E-Resistance to the passage of sound

- **There will be a new Part E1 for party walls which will state higher standards of sound insulation which place greater emphasis on resistance to transmission of low-frequency noise. The timber frame party wall currently in use is expected to easily meet the enhanced sound insulation.**

- **There will be a new requirement, E2, to provide improved sound insulation and privacy between a room containing a WC and a living room, dining room, study or bedroom, and also between bedrooms and other bedrooms and other rooms. This will probably mean that mineral wool insulation is included in internal walls and intermediate floors. An alternative might be to increase the density of the surface linings of the floors and the deck.**

Approved Document F - Ventilation (1995 Edition)

The F1 functional performance requirement is:

F1 Means of ventilation
There should be adequate means of ventilation provided for people in buildings.

The AD-F standards and approaches to meeting the functional performance requirement of *F1 Means of ventilation* are:

- The Table 3 ventilation provisions are given which involve a combination of rapid ventilation, typically an openable window with some part of the ventilation at 1.75 m above the floor; background ventilation, typically a slot controllable ventilator at the head of windows and extract ventilation, typically an extract fan or a passive stack ventilator (PSV) designed in accordance with the BRE Information Paper IP 13/94- *Passive stack ventilation systems: design and installation*:

Table 3: Room ventilation requirements for housing

Room	Rapid ventilation	Background ventilation	Extract fan or PSV
Habitable	1/20th of floor area openable	8,000 mm^2	None
Kitchen	Openable window any size	4,000 mm^2	Fan 30 l/s near cooker; Fan 60l/s remote or PSV
Utility room (to wash and dry clothes)	Openable window any size	4,000 mm^2	Fan 30 l/s or PSV
Bathroom	Openable window any size	4,000 mm^2	Fan 15 l/s or PSV
WC not in bathroom	1/20th of floor area openable or fan 6 l/s	4,000 mm^2	None

- As an alternative to *Table 3* above, the overall background ventilation provision for a dwelling can be equivalent to an average of 6000 mm^2 per room for each of the rooms listed above with at least 4,000 mm^2 in each room.

- Full mechanical ventilation systems can be an alternative way of providing ventilation. This would need to be in accordance with or equivalent to the requirements of:
  - BS 5720:1979- *Code of practice for mechanical ventilation and air-conditioning in buildings.*
  - BRE Digest 398- *Continuous mechanical ventilation in dwellings: design, installation and operation.*

The F2 functional performance requirement is:

F2 Condensation in roofs
Adequate provision must be made to prevent excessive condensation in a roof or a roof void above an insulated ceiling.

The AD-F standards and approaches to meeting the functional performance requirement of *F2 Condensation in roofs* are:

- Roofs with a pitch of 15^0 or more and insulation at flat ceiling level:
  - These roofs should have openings at the eaves on two opposite sides of the roof at least equal to a continuous opening of 10 mm wide.
  - For mono-pitch or lean-to roofs, the eaves ventilation should be as above and the openings at high level should be at least equal to a continuous opening of 5 mm wide.

- Roofs with a pitch of less than 15^0 and those where the ceiling follows the pitch of the roof (any pitch):

- These roofs should have ventilation openings in two opposite sides of the roof at least equal to a continuous opening of 25 mm wide.
- Roofs with a span of 10 m or more or, other than a simple rectangle in plan, may require more ventilation (i.e., 0.6 per cent of the roof area).
- The void between the top of the insulation and the roof deck should be at least 50 mm.
- For pitched roofs with insulation at ceiling level there should be openings at the ridge at least equal to a continuous opening of 5 mm wide.

- The requirements can be met by following the relevant Parts of BS 5250:1989- *Code of practice for the control of condensation in buildings.*

Approved Document K - Protection from falling, collision and impact (1998 Edition)

The K1 functional performance requirement is:

K1 Stairs, ladders and ramps
Stairs, ladders and ramps need to be designed, constructed and installed to be safe for people moving between different levels in a building.

The AD-K standards and approaches to meeting the functional performance requirement of *K1 Stairs ladders and ramps* are very detailed. Only the basic standards and approach are given:

- All the steps in a flight should have the same rise and going (a going is the same as tread). The practical limits for the rise and going in a single-occupancy house are a riser of 155-220 mm with a going of 245-260 mm or, a riser of 165-200 mm with a going of 223-300 mm; but with a maximum pitch of 42^0 in any case.

- Risers may be open but treads should then overlap by at least 16 mm. Stairs with open risers and likely to be used by children under five years need to be made so that a 100 mm diameter sphere cannot pass through the open riser.

- Headroom of 2 m is adequate on stairs and landings measured from the pitch line of the stair to the lowest part of the ceiling.

- There are no stair width requirements but means of escape [B1] and disabled access [M] must be considered.

- There is no limit in on the length of stair flights in houses.

- Landings should be provided at the top and bottom of all stair flights.

- Stairs need a handrail on one side if they are less than 1 m wide or both sides if wider. The handrail should be 900-1,000 mm from the line of the stair pitch to the top of the rail.

- Stair flights and landings should be guarded at the sides when there is a drop of more than 600 mm. The guard height should be 900 mm except for balconies where 1,100 mm is needed.

- The design of the guard should be such that a 100 mm sphere cannot pass through any opening and that children cannot easily climb the guarding.

The K2 functional performance requirement is:

K2 Protection from falling
Any stairs, ramps, floors, balconies, accessible roofs, lightwells, basements or other sunken areas should be provided with guarding to protect people from falling.

The AD-K standards and approaches to meeting the functional performance requirement of *K2 Protection from falling* are:

- Any wall, parapet, balustrade or similar obstruction may serve as guarding. The height should be 900 mm except for balconies where 1100mm is needed.

- Guarding should be able to resist the horizontal force given in BS 6399: Part 1.

- The design of the guard should be such that a 100 mm sphere cannot pass through any opening and that children cannot easily climb the guarding.

Approved Document L1 - Conservation of fuel and power in dwellings (2002 Edition)

The functional performance requirements are:

L1 Dwellings
Reasonable provision shall be made for the conservation of fuel and power in dwellings by:
(a) limiting the heat loss:
(i) through the fabric of the building;
(ii) from hot water pipes and hot air ducts used for space heating;
(iii) from hot water vessels;
(b) providing space heating and hot water systems which are energy-efficient;
(c) providing lighting systems with appropriate lamps and sufficient controls so that energy can be used efficiently;
(d) providing sufficient information with the heating and hot water services so that building occupiers can operate and maintain the services in such a manner as to use no more energy than is reasonable in the circumstances.

There is detailed guidance in AD-L1 concerned with alternative ways of limiting heat loss and the insulation and controls for services. Only the key basic AD-L1 standards and approach to meeting the functional performance requirements for heat loss and service provision are given here and exporters involved in more complete design may need to check AD-L1 for more detail. The basic AD-L1 standards and approaches to meeting the functional performance requirements of *L1 Dwellings* are:

- All dwellings must have a calculated energy rating using the Government's Standard Assessment Procedure (SAP). The procedure and worksheet is given in Appendix G of AD-L1. The procedure is relatively simple using the progressive "fill in the boxes" approach in Appendix G- there are also a number of approved (by BRE) computer programs which can also be used and the purchase cost is typically less than £500. As one method of demonstrating compliance with all the requirements of AD-L1, the Carbon Index from the SAP procedure can be calculated.

- There are three ways of demonstrating how heat loss through the building fabric can be limited:
  - an Elemental method;
  - a Target U-value method;
  - a Carbon Index method.

- The Elemental Method can be used only when the heating system will be based on an efficient (see Table 5) gas or oil boiler, on a heat pump, on community heating with CHP (combined heat and power) or on biogas or biomass fuel, but not for direct electric heating or other systems. This is the method most UK builders use. The Target U-value Method and the Carbon Index Method can be used with any heating system. The Elemental Method is simple to calculate and to understand as you just have to work out the U-values. The Target U-value Method allows trading between the insulation levels of fabric elements and can include solar gains. The Carbon Index Method takes into account solar and other gains and allows trading between the insulation levels of fabric elements and heating system efficiency. These latter two methods allow greater design freedom to meet the energy efficiency targets.

Table 4: Elemental Method: U-values (W/m^2K) for construction elements

Exposed Element	U-value	R_{metric} [6]	$R_{imperial}$ [6]
Pitched roof with insulation between rafters [1, 2]	0.20	5.00	28.4
Pitched roof with integral insulation	0.25	4.00	22.7
Pitched roof with insulation between joists	0.16	6.25	35.5
Flat roof [3]	0.25	4.00	22.7
Walls, including basement walls	0.35	2.86	16.2
Floors, including ground floors and basement floors	0.25	4.00	22.7
Windows, doors and rooflights [4] (area-weighted average), glazing in metal frames [5]	2.20	0.45	2.6
Windows, doors and rooflights [4] (area-weighted average), glazing in wood or PVCu frames [5]	2.00	0.5	2.8

Notes to Table 1:

1 Any part of a roof having a pitch of 70° or more can be considered as a wall.

2 For the sloping parts of a room-in-the-roof constructed as material alteration, a U-value of 0.3 W/m^2K ($R_{metric} = 3.33$; $R_{imperial} = 18.9$) would be reasonable.

3 Roof of pitch not exceeding 10°

4 Rooflights include roof windows

5 The higher U-value for metal-framed windows allows for additional solar gain due to the greater glazed proportion.

6 Units for R_{metric} are m^2K/W; units for $R_{imperial}$ are $ft^2°Fh/Btu$

Table 5: Minimum boiler SEDBUK* to enable adoption of the Table 4 U-values and reference boiler SEDBUK for use in the Target U value Method

Central heating system fuel	SEDBUK [1] %
Mains natural gas	78
LPG	80
Oil	85[2]

Notes to Table:

* Seasonal Energy Efficiency of a Domestic Boiler defined by SAP

1 For boilers for which the SEDBUK is not available, the appropriate seasonal efficiency value from Table 4b of the SAP may be used instead

2 For oil-fired combination boilers a SEDBUK of 82 per cent, as calculated by the SAP-98 method, would be acceptable

- The total area of windows, doors and rooflights should not exceed 25 per cent of the total floor area when using the Elemental Method.

- The window area can be varied under the Target U-value or Carbon Index methods. These two calculation methods offer the designer more flexibility to take into account solar and renewable energy and innovative building fabrics and equipment. For more detail AD-L1 should be checked.

- No matter what calculation technique is used there are still overall limiting U-values which the building fabric must not exceed. The maximum acceptable U-value for parts of a roof is 0.35 W/m^2K ($R_{metric} = 2.86$; $R_{imperial} = 16.2$) and for walls, this is 0.7 W/m^2K ($R_{metric} = 1.43$; $R_{imperial} = 8.1$).

- The building fabric should be constructed so there are no significant thermal bridges or gaps in insulation within the building elements, at joints and at the edges of elements. One way of demonstrating this is to use the guidance given in the document *"Limiting thermal bridging and air leakage: Robust construction details for dwellings and similar buildings"* The Stationery Office (2001).

- Reasonable provision should be made to reduce unwanted air leakage. However, the need for adequate room ventilation should be taken into account (see Part F above). Prescriptive guidance is given in section 8 of *"Limiting thermal bridging and air leakage: Robust construction details*

for dwellings and similar buildings" (2001). This is referenced as a method of demonstrating compliance. An alternative is to pressure test the building in accordance with the method in CIBSE [Chartered Institution of Building Services Engineers] Guide TM 23: *"Testing of buildings for air leakage"* (2000). An acceptable level is deemed to be an air permeability [leakage] not exceeding 10 m^3 per m^2 of external dwelling surface area at an applied pressure difference of 50 Pascals [Pa]. This is about 7 to 10 air changes per hour at 50 Pa which depends on the size of the house.

- Individual heaters tend to have integral controls, otherwise, the requirement for adequate heating controls will be met by the appropriate provision of:
  - zone controls and;
  - timing controls and
  - boiler control interlocks.

- AD-L1 deals only with hot-water storage systems where the storage vessel needs to be insulated.

- Heating and HWS [hot-water systems] systems should be checked at completion to ensure that they will work in an energy-efficient manner as they were designed.

- Building occupants should be given operating and maintenance instructions for the heating and HWS systems.

- Unless pipe or duct heat loss contributes to space heating they should be insulated.

- Reasonable provision should be made for occupants to have energy-efficient internal lighting. Guidance on luminaires (e.g., compact fluorescent lamps) and location is given.

- Reasonable provision should be made for occupants to have energy efficient external lighting. Guidance on luminaires (e.g., compact fluorescent lamps) and location is given.

- Conservatories are defined and essentially, if they are not separated from the house by insulated walls and/or are heated they require energy saving measures. In simple terms this means that they are taken as part of the house and the glazed part comes into the 25 per cent if using the Elemental Method or is taken into account in terms of heat losses and gains for the Target U-value and Carbon Index Methods.

Approved Document M - Access and facilities for disabled people (1999 Edition)

The functional performance requirements are:

M1 Interpretation
Disabled people means people who have:
(a) an impairment which limits their ability to walk or which requires them to use a wheelchair for mobility,
(b) impaired hearing or sight.
M2 Access and use
Reasonable provision should be made to enable disabled people to access and use buildings
M3 Sanitary conveniences
Reasonable provision should be made in the entrance storey of a dwelling for sanitary conveniences.

The AD-M standards and approach to meeting the functional performance requirements of *M1, M2 and M3* are as follows (except those related to external works such as ramps, steps etc. as they are not normally relevant to exporters, unless the complete design package is to be offered):

- The objective is to make reasonable provision within the boundary of the plot for a disabled person to approach and gain access to the dwelling after arriving "at the plot," preferably via a level or ramped access "across the site."

- Where the approach is level or ramped an accessible threshold should be provided at the main entrance to all new houses. For a level or ramped approach an accessible threshold should be designed in accordance with the Department of the Environment, Transport and the Regions (DETR) booklet "*Accessible thresholds for new housing*" (1999), The Stationery Office.

- To provide access for disabled people the external entrance door should have a minimum clear opening width of 775 mm.

- A corridor and door clear opening widths to habitable rooms or to a room containing a WC on the entrance storey should be as in Table 6:

Table 6: Minimum widths of corridors related to door widths

Doorway clear opening width (mm)	Corridor width (mm)
750 or wider	900 (approach head on)
750	1,200 (approach not head on)
775	1,050 (approach not head on)
800	900 (approach not head on)

- Switches and socket outlets for lights and power should be located between 450 and 1,200 mm from floor level.

- A WC suitable for disabled use in the entrance storey may be in a bathroom. It will not always be practical for a wheelchair to be fully accommodated within the WC compartment. The door to the compartment should open outward and have a clear opening at least as big as indicated in Table 6. The compartment should provide a clear space for wheelchair users to access the WC, and the basin should not impede access.

Approved Document N - Glazing - safety in relation to impact, opening and cleaning (1998 Edition)

The functional performance requirement is:

N1 Protection against impact
Glazing which people could contact should:
(a) break in a safe way
(b) resist impact without breaking
(c) be shielded or protected from impact.

The AD-N standards and approaches to meeting the functional performance requirement of *N1 Protection against impact* are:

- The following locations are considered "critical" in terms of safety for glazing:
  - up to 800 mm above floor level in walls.
  - up to 1,500 mm in doors and door side panels.

- Glazing in critical locations should either:
  - Break safely—safe breakage is defined in BS 6206 which simplistically says the broken glass should be in small pieces without sharp edges.
  - Be robust or in small panes—annealed glass of sufficient thickness or polycarbonate or glass blocks may protect against impact but may not be practical in housing; small panes have a smaller dimension of not more than 250 mm and an area not exceeding 0.5 m^2, the glass should be 6 mm.
  - Be permanently protected—permanent screen protection should:
    - prevent a sphere of 75 mm from coming into contact with the glazing
    - be robust
    - be difficult to climb
    - the screening should extend up to 800 mm above the floor.

Approved Document to support Regulation 7 - Materials and workmanship (1999 Edition)

The functional performance requirement is:

Building work should be carried out using adequate and proper materials in relation to their circumstances and function and in a workmanlike manner.

The AD standards and approaches to meeting this requirement are:

- There are a number of ways of establishing the fitness of materials:
  - British, EU or ISO Standards
  - European Technical Approvals
  - CE marking
  - Independent certification schemes
  - Tests and calculations by an independent body
  - Past experience.

- The appropriate workmanship can be established by:
  - British, EU or ISO Standards
  - European Technical Approvals
  - Management systems (e.g., BS EN ISO 9000)
  - Past experience.

- A material likely to be adversely affected by condensation, by moisture from the ground or by rain or snow should:
  - Be protected in a construction which resists the passage of moisture to the material.
  - Be treated or otherwise protected from moisture.

- These means of establishing fitness of materials and components is considered in more detail in *Section 4: Product and System Approvals and Certification Procedures.*

APPENDIX 2: AN OVERVIEW OF BUILDING REGULATIONS FOR SCOTLAND AND NORTHERN IRELAND

Scotland and Northern Ireland are separate countries within the United Kingdom and are proud of this country status. One of the manifestations of this independence is the existence of national building regulations separate from and different to, those which operate in England and Wales.

These regulations are:

- **The Building Standards (Scotland) Regulations 1990 as amended**—The Scottish Executive is responsible for drafting and administering these Regulations.

- **The Building Regulations (Northern Ireland) 2000**—The Department of the Environment for Northern Ireland is responsible for drafting and administering these Regulations.

The England and Wales regulations apply to approximately 155,000 new housing starts annually and the timber frame market share is about 6 per cent . The Scottish regulations apply to 20,000 new houses per year and the market share for timber frame is around 57 per cent . In Northern Ireland the regulations apply to 10,000 new housing starts and the estimated timber frame market is 2 per cent. Clearly England and Wales is by far the biggest potential market for growth in timber frame.

In principle, the approach of each of the three sets of UK building regulations are the same. Performance requirements are set to ensure health and safety in and around buildings, that buildings do not result in the consumption of excessive energy (in recent regulation amendments this has been more targeted at CO_2 emission reductions) and that there is reasonable access to buildings for disabled people. In the detailed methods described to show compliance with the general performance requirements there are many small but significant differences in each of the three sets of documents. An analysis of these differences and their impact on certain construction forms, such as timber frame, is a major study in itself.

The Northern Ireland and the Scottish regulations, like those in England and Wales, are mostly a set of **minimum** standards for health and safety. The exceptions are the thermal insulation parts, which give minimum standards to reduce CO_2 emissions and thereby reduce the impact of greenhouse gases and, the disabled access parts in order to meet acceptable social standards. They are arranged by function (e.g., fire safety or sound insulation) and not by element (e.g., wall, floor or door). The actual legal requirement is a simple functional performance statement but guidance on how to meet this requirement is different in the two countries.

The Scottish regulations give functional performance requirements at the beginning of the Part of the Standards; for example, in Part K: Ventilation "... a building shall have means of providing adequate air for users of the building." Further detail of what rooms are to be ventilated and what are excluded is given later in the Part; "... no requirement for rooms less than 4 m^2", and then at the end, a "deemed to satisfy the Standards" provision is given; "... use a trickle ventilator with an

opening of 4000 mm^2." All of the requirements and advice for all of the Parts are in one document. The legal system is different in Scotland than in England and Wales and the "deemed to satisfy" provisions, while not strictly mandatory, tend to be a higher "status of compulsion" requirement than the advice in the England and Wales AD's.

As an example of the major differences in the Scottish Standards to those in the AD-B, the fire safety guidance in the Standards discriminates against the use of timber for stair enclosures in flat developments and restricts the height of certain buildings using timber construction.

The Northern Ireland regulations give the performance requirement in a "statutory document" and the guidance on how to meet this requirement is given in a series of Technical Booklets, similar in appearance to the AD's. However, the Booklets are set out in a similar format to the Scottish standards and have a "deemed to satisfy" provision at the end of each requirement within the Part. For example, E2- *Means of escape* is followed by E3- *Deemed to satisfy provisions for means of escape*. The format looks like the England and Wales regulations but the content is like the Scottish regulations and the "deemed to satisfy" provisions, while not strictly mandatory, tend to be a higher "status of compulsion" requirement than the advice in the AD's.

The Northern Ireland regulation detailed guidance differs from both the other UK regulations and tends to pick aspects from each to suit their own needs. The guidance tends to be more restrictive in fire safety terms for the use of timber frame structures than that in AD-B. The guidance is also more onerous in terms of the use of timber as a cladding material.

The Approved Documents to the *The Building Regulations 2000* for England and Wales relevant to exporters for housing up to three storeys are shown in the Table 7 below with the equivalent Parts for Scotland and for Northern Ireland.

Table 7: Building Documents in England, Wales, Scotland and Northern Ireland

ENGLAND AND WALES	SCOTLAND	NORTHERN IRELAND
Approved Document A - Structure	Part C- Structure	Technical Booklet D - Structure
Approved Document B - Fire safety	Part D- Structural fire precautions Part E- Means of escape, facilities for fire-fighting and means of warning of fire	Technical Booklet E- Fire safety
Approved Document C - Site preparation and resistance to moisture	Part G- Preparation of sites, Resistance to moisture and Resistance to condensation	Technical Booklet C- Preparation of site and resistance to moisture
Approved Document E -	Part H- Resistance to...	Technical Booklet G-

Resistance to the passage of sound	transmission of sound	Sound insulation of dwellings
Approved Document F - Ventilation	Part K- Ventilation of buildings	Technical Booklet K- Ventilation
Approved Document K - Protection from falling, collision and impact	Part S- Access to and movement within buildings, and protective barriers	Technical Booklet H- Stairs ramps and guarding
Approved Document L1 - Conservation of fuel and power in dwellings	Part J- Conservation of fuel and power	Technical Booklet F- Conservation of fuel and power
Approved Document M- Access and facilities for disabled people	Part Q- Access and Facilities for dwellings	Technical Booklet R- Access and facilities for disabled people
Approved Document N- Glazing - safety in relation to impact, opening and cleaning	Part P- Miscellaneous hazards	Technical Booklet V- Glazing
Approved Document for Regulation 7- Materials and workmanship	Part B- Fitness of materials and workmanship	Technical Booklet B- Materials and workmanship

APPENDIX 3: THE HOUSING CORPORATION "SCHEME DEVELOPMENT STANDARDS" FOR SOCIAL HOUSING

The UK has a large established market for the provision of new social housing. There are 20-24,000 homes constructed annually. The government's £1.5 billion investment into social housing is delivered through its agent, the Housing Corporation. The Housing Corporation allocates funds on an annual basis to Registered Social Landlords (RSL's) who maintain responsibility for development of the housing stock and the upkeep and maintenance over the lifetime of the dwellings. These RSL's can be local authorities or registered housing charities usually called Housing Associations.

There are about 2,500 Housing Associations in the England and Wales market. To ensure that a minimum standard of development is obtained, the Housing Corporation has a monitoring or policing role to effectively regulate how social housing is constructed and managed. In terms of construction, the requirements for social housing are set out in the Housing Corporation's Scheme Development Standards (SDS's). These Standards, which are amended annually, provide a design template for those interested in developing housing stock in the sector. The SDS's are **in addition** to the statutory building regulation or housing warranty requirements.

The Scheme Development Standards are presented under eight headings:

1.1 External Environment
1.2 Internal Environment
1.3 Accessibility
1.4 Safety and Security
1.5 Energy Efficiency, Environmental Sustainability and Noise Abatement
1.6 Maintainability, Durability and Adaptability
1.7 Temporary housing (2-14 year leases)
1.8 Temporary housing (15-29 year leases)

Under each heading a series of tests for compliance with performance are presented. These are divided into two categories:

1. Essential items
2. Recommended items.

The essential items are in effect mandatory although in special cases, waivers can be given on a scheme specific basis. The recommended items are either "best practice" thinking or, are new issues under consideration by the Corporation for future inclusion as essential items following a period of evaluation.

Canadian companies interested in exporting to the UK for social housing would need to be familiar with the detail of the SDS's.

APPENDIX 4: GLOSSARY OF BUILDING CONSTRUCTION TERMS

approved structural engineer- a person accredited with skills in timber structural design, usually also a Chartered Engineer. In practice most clients select from the NHBC approved list and this is accepted by all building control authorities.

Binders- horizontal framing running perpendicular to and above the lower chord of roof trusses

breather membrane- the same as breather paper but it is now not "paper"; Tyvek is a common trade name membrane. It is water and air tight but allows rapid water vapour diffusion

BS- British Standard

BS EN- European Standard (Euro-Norm) agreed and accepted in the UK

BS EN ISO- International Standards Organization (ISO) standard agreed and accepted by the EU and the in the UK

cavity barriers- 30-minute fire resisting barriers in the cavity outside the timber frame, behind the cladding, to restrict the spread of smoke and fire in the concealed cavity space

CE Mark- a mark of the European Community harmonized standards, "conformité Européen." It is a mark to show compliance with the standard, not a mark of quality.

cement render- sand, cement and water mix applied to walls as a three-coat cementitious cladding either smooth, textured or with surface "pebbles" added. It is the same as old-fashioned "stucco."

Chipboard- the same as particleboard

Conservatories- other names are greenhouse, sunspace or glasshouse. Conservatory is used when the glazed enclosure is attached to the house and forms part of the living area rather than a space for growing plants, usually as an outbuilding.

cut roof- traditional site-built roof framing using rafters and purlins

DETR- Department of the Environment, Transport and the Regions (does not now exist! Construction is under the Department of Trade and Industry (DTI) and Building Regulations are in the Office of the Deputy Prime Minister (ODPM))

Dpc- damp proof course used in walls to resist rising ground moisture

dpm- damp proof membrane used under floors to resist ground moisture

extract ventilation- ventilation using powered extract fans, usually to extract moist and/or stale air from "wet" rooms such as kitchens or bathrooms.

fire doorsets- this is the complete fire resisting door package and includes the door, the frame and the ironmongery (hinges, handles etc.). To perform as in the original fire test for the doorset, the complete test package must be specified.

Fire stops- these are materials or components which seal imperfections in a fire restisting element e.g. around services or provide continuity of the fire resistance at the edge of the element e.g.; around all edges of a party wall.

first fix services- the basic wiring and back boxes for electrics and the pipes or ducts for water and air i.e.; rough-in services

headbinder- a timber rail above the top rail of a prefabricated timber frame panel. It binds wall panels one to the other in-line and at corners and distributes loads so the joists and rafters do not have to line with studs. It does not distribute high point loads.

impregnated softboard- a board made using wood fibres, water and heat; compressed and impregnated with a substance to enhance durability and water resistance (usually bitumen (asphalt)). These boards can be used as structural sheathing to walls and roofs without a separate breather membrane.

Linings- interior finishes such as gypsum wallboard, wood boards or anything that meets the aesthetic and technical requirements.

Noggings- blocking, nailers i.e: lumber members fixed laterally between the structural studs joists or rafters.

passive stack ventilator (PSV)- a pipe which runs from a wet room (usually wet but could be any room needing extract ventilation) to the roof ridge to extract air from the room. It works because of the stack or buoyancy effect (height and temperature difference) but is also related to wind speed. To work well the building must be reasonably airtight and the extraction "self-throttles" based on the inlet opening i.e.; the slot ventilator (open or not) and leakage. If a house was very leaky it might never self throttle and would be like an open chimney in an old-fashioned house.

Perpends- vertical joints in masonry

Polythene- brand name for polyethylene or plastic sheeting. It is now considered a generic name for polyethylene in the UK

Rafts- a reinforced concrete foundation slab working in three dimensions to "span" over poor ground support

rails- horizontal lumber members at the top and bottom of a timber frame panel.

Rooflight- a window on the same pitch as the roof in which it is located; the same as a skylight

Sarking- roof sheathing of OSB, plywood or fibreboard (only Scotland) and/or a roof sheathing membrane (a bitumen (asphalt) felt, Tyvek etc.)

skirtings- decorative trim at the base of a wall, traditionally wood but now increasingly MDF

social housing- housing built for low-income and/or socially deprived people for affordable renting. This is usually built by Housing Associations in their local area but can be built by the Local Council. The Government pays for most of this through its agency The Housing Corporation.

sole plate- an horizontal lumber member fixed down to the foundation which forms a base template for all the house walls. The bottom rails of the timber panels are fixed down to the sole plate.

strutting- lumber or steel elements fitted between floor joists to provide extra stiffness to floor. It is the same as bridging.

Tanking- basement or below dpc waterproofing

terraced housing- row housing

two-leaf wall- the term is usually applied to party walls and means two stud walls side by side with a 25-75-mm cavity between and which are tied together with metal straps.

upstand- anything which stands up from the general floor level. It could be the rails of timber frame panels, a masonry fireplace hearth, etc.

vapour control layer- the same as an air and vapour barrier; 0.12-mm polyethylene is common but proprietary vapour control (metalfoil/polymer) backed plasterboard continues to grow in market share

verge- the sloping top of a gable wall, usually at the outside face

water closet (WC)- a flush toilet or a room containing a toilet

waxed mediumboard- a board made using wood fibres, water and heat; compressed and waxed on the outer surface to enhance water resistance. These boards can be used as structural sheathing to walls and roofs without a separate breather membrane.